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NOTES AND COMMENTS.

Against the Tide.

A CRANK has been defined as a man whose position is so different from our own that we utterly fail to understand it. But this definition is too charitable; it ignores the public aspect of the crank, who not only occupies an unintelligible position, but bores you by insisting upon it. The crank is essentially a house-top man, not one in a corner. Yet we would not call any one a crank, for by the definition this would proclaim our own lack of understanding. We would only say that there are some whom some would call cranks, and we have just received a paper from one,—a paper entitled "Fausseté de l'idée évolutionniste appliquée au système planétaire ou aux espèces organiques" (Lyon, 1899, 7 pp). The author, Mr. F. Leport, has previously tried to convince geologists that there are no faults around Morvan, to convince astronomers that the nebular hypothesis is gratuitous, and to convince others about other things, and now he tries to convince us of the falseness of the evolution-idea. What he has convinced us of is, of course, that he does not understand it at all. He opposes it to the idea of creation, which no sensible man ever does, for to do so is to quarrel about punctuation. He finds that the law of existence is undulatory movement, and that the origin of the movement is divine—a platitudinarian belief which affects the evolutionist not one whit. He tells us about the homogeneity of protoplasm and the infertility of hybrids (surely we might have been spared *that*), and so with other matters, when he gets near facts he shows by mishandling them that he does not realise their solemnity. He tells us that a thesis of St. George Mivart's entitled "Evolutionisme restreint aux corps organiques" was examined at Rome by competent authority and judged "insoutenable" so far as it dealt with the body of man, and his lament is that the verdict was so limited in its disapprobation—"signe terrible des temps troublés où nous vivons." We would borrow from the Roman authority the word "insoutenable," and fix it to Mr. Leport's mistaken attempt to talk wisely about matters which he shows no evidence of understanding.

A Rare Rotifer.

IN October 1859 Professor Semper discovered in some ditches intersecting rice-fields in the Philippine Islands a remarkable spherical rotifer, which he named *Trochosphaera aequatorialis*, in allusion to the ciliary wreath which divides it into two hemispheres. For thirty years nothing more was seen of the creature, until Surgeon Gunson Thorpe found it (1889) in Fern Island pond of the Botanical Gardens at Brisbane. In 1892 he discovered in some irrigation creeks and ponds near Wuhu on the Yangtsze Kiang a new species (*T. solstitialis*) in which the ciliary wreath encircles the body as the Tropic of Cancer does the earth. In 1896 the same species was found in the Illinois River by Dr. C. A. Kofoid, and in 1898 by Mr. H. S. Jennings, in a pond close to Lake Erie. We have taken this information from a short note by Mr. C. F. Rousselet (*Journ. Quekett Micr. Club*, vii. (1899) pp. 190-193, 1 fig.) who recently exhibited to the Quekett Club a slide of *T. solstitialis*, prepared according to his method by Mr. Jennings. This was the first time the animal had been seen in the flesh in England. "The anatomy is extremely simple and beautifully displayed, all the organs, usually so indistinct and closely packed together in rotifers, being here spread out and suspended in the transparent sphere in the most delightful manner." It is said that Dr. Kofoid is preparing a full account of this remarkable type.

Does the Organism Repeat Itself?

IN an interesting paper entitled "Localised Stages in Development in Plants and Animals" (*Mem. Boston Soc. Nat. Hist.* v. (1899) pp. 89-153, 10 pls.), Mr. Robert Tracey Jackson elaborates an interpretation which is in direct line with the ideas expressed by Hyatt, Cope, Ryder, Beecher, and some other American workers. It is especially in harmony with Hyatt's law of senile characters:—"In the old age, stages are found which are similar to stages found in the young, and are prophetic of types to be found in degradational series of the group to which the animal belongs." But Mr. Jackson's particular point is that in addition to stages in the young and in the old age, stages may be found in localised parts throughout the life of the organism.

"In organisms that grow by a serial repetition of parts, it is found that there is often an ontogenesis of such parts which is more or less closely parallel to the ontogenesis of the organism as a whole. In the ontogeny of such localised parts in a mature individual we find stages in development during the growth of the said parts which repeat the characters seen in a similar part in the young individual."

Such localised stages have been observed in the leaves of plants, in branches or suckers of plants, in the budding of some of the lower

animals such as *Hydra* and *Galaxea*, in the plates of crinoids and sea-urchins, in external ornamentations in molluscs, and in the septa of cephalopods. They must be clearly distinguished from stages in the development of the organism as a whole, for they are features seen in localised parts throughout the whole life, or are capable of being brought into existence by certain conditions throughout the life.

The author adduces a large number of illustrations from plants and animals, and sums up: "The occurrence of localised stages, and their bearing, may be expressed in the following law, which should be compared with the laws concerning youthful and senile stages:—Throughout the life of the individual, stages may be found in localised parts which are similar to stages found in the young, and the equivalents of which are to be sought in the adults of ancestral groups. While this law covers the usual conditions, it is possible and even probable that degradational or progressive features may appear as localised stages. To include such cases the following clause may be added: The equivalents of regressive or progressive localised stages are to be sought in the adults of degradational or progressive series of the group."

Mr. Jackson's thesis is an attractive one whose applicability must be tested in detail and with impartiality, and it will be interesting, therefore, to see how experts on foliage and budding, fossil sea-urchins and cephalopods deal with it. That it is a luminous suggestion carefully illustrated and tested, and not a mere bow drawn at a venture, is something to be thankful for.

Nephrite.

In the *Globus*, vol. lxxv. No. 18 (May 6, 1899), attention is called by A. B. Meyer to some fresh occurrences of nephrite in Styria. In 1883 he found pebbles or rolled fragments of it in the river-beds of the Sann, near Cilli, and the Mur in Gratz. That these pieces of nephrite were really pebbles was, in both instances, questioned, some considering them to be stone implements which had been more or less water-worn and rounded.

In 1888 Berwerth also found nephrite in the bed of the Mur, and in the present year discovered three more examples among the rolled fragments of that river, one of them measuring 3·6 metres.

These later finds are considered by Berwerth to remove all doubt concerning the occurrence of nephrite in Styria, and to indicate that it will probably be met with forming thin beds in the metamorphic rocks in the vicinity of the river Mur, an opinion in which Meyer, from his earlier observations, perfectly concurs.

The Ordeal by Fire.

A YEAR or two ago, Drs. Hocken and Colquhoun of Dunedin witnessed the fire-walking ceremony in Fiji, and their scientific zeal led them to lick the soles of the feet of the natives who were about to walk over the red-hot stones to ascertain whether any substance had been applied to them. Colonel Gudgeon, British resident at Rarotonga, has now gone one better and walked over the stones himself, and appears to have enjoyed it.

In the March number of the *Journal of the Polynesian Society*, published in Wellington, N.Z., he says that the tohunga, or priest, first took across Mr. Goodwin, at whose place the ceremony was performed. He then said to Mr. Goodwin, "I hand my mana (power) over to you; lead your friends across." Mr. Goodwin then led Colonel Gudgeon and two other Europeans across. Colonel Gudgeon got across unscathed, and only one of the party was badly burned. They all walked with bare feet, and after they had done so, about two hundred Maoris followed. Colonel Gudgeon did not walk quickly across the oven—which was about 12 feet in diameter—but with deliberation, for he feared that he might tread on a sharp point of the stones and fall, as his feet were very tender. His impression as he crossed the oven was that the skin would all peel off his feet, but all he felt when the task was accomplished was a tingling sensation, not unlike slight electric shocks, on the soles of his feet, and this continued for seven hours or more. Many of the Maoris thought that they were burned, but they were not, at anyrate not severely. Although the stones were hot enough an hour afterwards to burn up green branches, the skin of Colonel Gudgeon's feet was not even hardened by the fire.

We should like to know the experience of Dr. Craig, who was badly burned. Was he one of the percentage who are said to be non-susceptible to suggestion? Or is the solution elsewhere?

American Species of Peripatus.

THE suggestive value of the systematic study of the species of *Peripatus* is well known. The isolated position of the type, its archaic and synthetic characters, its wide distribution, its great diversity of structure within narrow limits, the differences in the modes of development in the several species, and other considerations, lend special interest to the detailed working out of the taxonomy. The student of species is here almost forced to face the problem of origins.

In a recent communication on the American species (*Comptes Rendus Acad. Sci. Paris*, cxxviii. 1899, pp. 1344-1346) Mr. E. L. Bouvier notices some results of general interest. He mentions the

occurrence of *Peripatus* in some localities not previously recorded—Mexico, Guadeloupe, and Antigua. He notes that the American forms agree in having lingual teeth formed by a chitinous cone whose internal cavity opens by an apical orifice, in showing a clear dorsal median line usually attenuated to microscopic dimensions, and also a clear (probably sensory) organ on each side of the clear dorsal line in each of the grooves of the body. These organs are absent or atrophied in the African species (except *P. tholloni*) and in those of Oceania. But of greater interest is the note that the American species form small regional groups, more or less distinct, so that it may almost be predicted that each island of the Antilles has its particular species or variety.

Wearing of the Green.

ONE always welcomes a paper—however short—from Prof. Dr. August Gruber, so well known for his investigations on the Protozoa. One of his latest contributions (*Ber. Naturf. Ges. Freiburg*, xi. 1899, pp. 59-61) describes the prosperity of a colony of green amoebae which he observed for about seven years. The colony hailed from a water-basin in the Connecticut valley, and came to Europe in some dried bog-moss in a letter from Prof. Wilder. The green amoebae fed at first on what they could get in the vessel in which the bog-moss was placed; they devoured rotifers and various forms of rhizopods; but soon they and green specimens of *Paramaecium bursaria* were left in possession of the field of pure Freiburg water. No conjugation was observed, and, still more strange, no division, though crops of small forms appeared in continuous succession. The condition of prosperity was obviously to be found in the chlorophyll of the zoochlorellae in the amoebae, and in the sustained illumination. Samples placed in darkness soon came to an end. Thus Dr. Gruber has shown that organisms which are in ordinary circumstances holozoic may by the wearing of the green prosper for many years in a holophytic existence.

Brevis esse laboro, obscurus fio.

WRITERS of scientific papers, of text-books, and of museum-labels are ever too apt to judge of other people's knowledge by their own. Now one may be no fool and yet be absolutely ignorant of many matters that the specialist has at his fingers' ends. An author therefore should do himself the justice to remember that his papers may possibly be referred to by the general zoologist, or by the "remote, unfriended, solitary" (and shall we add?) occasionally "slow" student, and he

should write accordingly. There is a certain tendency to brevity, born either of natural slothfulness or of a more laudable thrift, but in all cases to be kept under restraint. This tendency is very noticeable when an author begins to quote from others. Nowadays mere shame prevents one from omitting the bibliographic reference altogether; but, oh! how easy it is to keep it short and to render it just so unintelligible that the reader will never bother to verify it! With what apparent sincerity, what underlying artfulness, we allude to "a ridiculous statement by M. Chose (C.R. CIX. '87, p. 20)" or to "the great discovery by A. M'Grabham (P.R.S.E., V. p. 251)"! These cabalistic letters are in themselves enough to give an air of supreme authority to our estimate. A few such references constitute an impregnable line of fortifications.

A further instance of the obscurity begotten of brevity is furnished by that peculiar convention which forbids the zoologist and botanist to write a fellow-worker's name in full when quoting him as authority for a generic or specific name. To write "De Candolle" instead of "DC," "Linnæus" instead of "L." or "Danielssen and Koren" instead of "D. & K." would stigmatise one's work as that of a mere beginner, unworthy of serious consideration. Naturally the constant repetition of the same name or names many times on every page of a systematic work would be intolerable, and if it really be absolutely necessary to quote the authority for every specific name each time it is used, then some fairly intelligible abbreviation is forced upon one. We, however, have often expressed our opinion that such repetition is an idle absurdity. But, just in those cases where the citation of an author's name would be useful, there the customary abbreviation is apt to deprive it of any value. The visitor to a museum sees a label "Wood of *Abies nobilis* Ldl."; the reader of a natural history book finds under a figure "Shell of *Voluta nivosa* Lam." What, beyond mere bewilderment, can these symbols convey to his mind? And in these places brevity is not needed, for there is nearly always plenty of space to spare in a label or a legend. Here are some contractions taken at random from a text-book of zoology; we should like to know how many professed zoologists, to say nothing of university students, can say straight off what they mean:—M. & W., W. & M., Fbs., Tric., Stp., Mas. & Alc., Wr., M. & T., Gm., M. V. K. To attempt to regularise these contractions, as the Germans have done, by the publication of a list of authors' names, is only to emphasize the evil. A new edition of such a list would be needed each year, and even if it were rigidly adhered to by systematists, one could not expect every field-botanist or every lover of birds to keep a copy perpetually at his elbow. No! let us give up this attempt to put natural science on a par with the missing word competition. Do what we may, the *Annals and Magazine of Natural History* will never attain the popularity of *Answers* or *Pearson's Weekly*.

The preceding remarks were prompted by a paper entitled "A Hunt for a Name," contributed by T. S. Hall to the *Victorian Naturalist* for May, 1899. The difficulties to which we have alluded are of course magnified in outlying parts of the world, where fellow-workers are few. In trying to name a coral, Mr. Hall found himself referred by the reporter of the *Challenger* to "*Plesiastraea urvillei*, Milne-Edwards and Haine, Cor. II., p. 490." On this "almost meaningless reference" Mr. Hall remarks: "When one knows the country it is easy for him to find his way about, but to the stranger it is not easy, and he needs the finger-posts which the other never heeds. 'Cor. II.' is good enough for the specialist, but is a meaningless 'blaze' for the 'new chum.'" We are glad that Mr. Hall refused to regard "Cor. II." as a Biblical reference, and that he eventually discovered "Histoire Naturelle des Coralliaires"; but what language would he have used had the *Challenger* reporter followed the custom of his kind, and contented himself with "*P. urvillei*, E. & H., Cor. II."?

The Parietal Eye.

THE parietal eye and adjacent organs of the New Zealand Tuatera (*Sphenodon*) form the subject of an important paper by Mr. A. Dendy in the May issue of the *Quart. Journ. Micr. Soc.* It has already been shown that in the adult of this reptile this eye is better preserved than in other animals; and the author now demonstrates that its development has undergone less modification than in other reptiles. The first indication of its appearance is seen at a stage (*K*) comparable with a two-day-old chick, when a "primary parietal vesicle" buds on the roof of the fore-brain slightly to the left of the median line. At stage *N* the eye forms a hollow vesicle in front and slightly to the left of its so-called "stalk"—the "parietal stalk," which is a finger-shaped diverticulum of the root of the fore-brain, practically in the middle line. The eye is almost or completely separated from the stalk, which contains a prolongation of the cavity of the brain. The "paraphysis" likewise makes its appearance at this stage, as a backwardly-directed outgrowth of the roof of the fore-brain.

At stage *O* the parietal eye and stalk are conspicuous externally; while at stage *R* (the one immediately before hatching) the eye, which is now apparently median, is seen as a white spot with a black border, the latter representing the pigmented margin of the retina and the former the lens. In the adult (stage *S*) the eye, though very highly organised, is no longer recognisable externally; but in recently hatched individuals it is stated to be still visible as a dark spot through the translucent skin covering the parietal foramen.

After discussing the structure of the eye and its nerve, and the

relations of the former to the stalk, the author states that the evidence in favour of the originally paired character of the parietal eye is derived principally from the fact that it arises to the left of the median line, while the stalk is practically median, and therefore slightly to the right of the eye. Accordingly the parietal eye in *Sphenodon* is regarded as the left of the original pair, while the right one is represented by the parietal stalk. It is shown that the origin of the latter appears to be precisely similar to that of the former; and the two have also a very similar structure, although the stalk never acquires the same degree of perfection as the eye.

The relations between the parietal stalk, the "epiphysis," and the brain are next discussed, not only in *Sphenodon,* but in Lizards, Cyclostomes, and Fishes. It is shown that in the two reptilian groups the epiphysis, or pineal gland, is a composite structure, in which the paraphysis takes a large share, whereas the parts comparable to the epiphysial outgrowths of Fishes form but a small one. In Lizards the stalk may represent either the right or the left parietal eye. Beyond that of fellowship, the parietal eye has no real connection with the parietal stalk, being supplied with a special nerve of its own quite distinct from the stalk. Finally, it is inferred that the ancestors of existing Vertebrates were furnished with a pair of parietal eyes, which may have been serially homologous with the existing functional pair of ordinary eyes.

The Expansion of the Empire of Ribbed Toads.

A SINGLE ribbed toad has been found at Humptulips, Washington, U.S.A. This simple statement involves a noteworthy fact. The suborder of tailless batrachians, known as Costata, embracing the single family Discoglossidae, to which the new genus belongs, "has been credited with a most extraordinary geographic distribution. Until now it was composed of four genera, three of which are confined to the south-western corner of the palaearctic region, except a single species at the south-eastern end of the same region. The fourth genus, composed of a single species, represents, alone, the batrachia in New Zealand. None of the seven species known to form this sub-order consequently had been found in the Western Hemisphere at all, and none has thus far been taken in tropical Africa, Australia, or Asia, with the above exception. The addition of a typical costate genus to the fauna of North America is therefore not only an interesting novelty in itself, but it emphasises the fact that we have as yet much to learn about the geographical distribution of the vertebrates even in regions which have been fairly well explored." Thus writes Mr. Leonhard Stejneger, who describes the specimen in *Proceedings of the U. S. National Museum* (xxi. pp. 899-901, pl. lxxxix. June 1899).

The genus is called *Ascaphus*, meaning "spadeless," apparently because the sternum appears as a narrow band of cartilage only, without posteriorly diverging lateral styles as in other genera. But since the sternum "had been considerably damaged by the collector cutting open the abdomen to admit alcohol to the intestines," its shape is "a little doubtful," and may possibly not justify the generic name. An undoubted criterion is afforded by the position of the vomerine teeth, which are between the choanae, and not, as in other genera, behind them. The species is called *A. truei*, because Dr. True is the author's official chief. The sex of the unique specimen is not stated.

Degrees of Protective Adaptation.

An examination of the contents of the stomach has often proved of value in biological research, though it may seem to some a dull way of getting at the secrets of life. We have learned, for instance, not a little in regard to the habits of fishes through the patient labours of those who have analysed the contents of fishes' stomachs; and a recent research by Mr. Sylvester D. Judd (*Amer. Naturalist*, xxxiii. 1899, pp. 461-484), who has examined the stomachs of fifteen thousand birds, is an important contribution towards solving one of the most intricate problems of biology—the efficiency of protective adaptations.

These protective adaptations in insects are, as every one knows, extraordinarily diverse, but the most important are included under the following heads:—resemblance to surroundings; hairs; stings or poisonous bites; ill-flavoured, ill-scented, or irritating properties; warning coloration; and protective mimicry. These are the headings used by Mr. Judd in his paper, the broad result of which shows that the supposed protections of insects are certainly not always baffling to birds. He gives a long list of so-called protected forms, and of the birds which nevertheless prey upon them.

We agree entirely with the author when he says: "It seems to me that there are different degrees of protective adaptations—that some are much more effective than others. There is need of some standard of the efficiency of protective adaptations, *i.e.* a measure of their working forces. Some of the writers on the subject have led one to suppose that a good many protective devices secure almost complete immunity from the attacks of birds; while other investigators have been tempted, when they found in particular instances that facts, apparently, did not coincide with current views, to abandon the theory entirely."

There is an anthropomorphism in biology which is hardly to be got rid of. Because an insect is unpalatable to us we argue that it must be distasteful to a bird; but "it does not follow," Mr. Judd

says, "that since a stink-bug nauseates our stomach and irritates our tongue, it will produce a like effect on a crow." There appears to be need of a little more avian psychology, as he quaintly phrases it. "Numerous species of bugs and beetles which, in addition to being protectively coloured, possess ill-smelling, bad-tasting, and irritating secretions, would naturally be supposed by some writers to be avoided generally by nearly all birds, but they are habitually eaten by many birds of the eastern United States."

The conclusion seems to be, as we have said before in these columns, that adaptations are by no means so perfect as is often supposed. Protective adaptations may lessen the chances of death, and thus be of much evolutionary importance without being in any wise perfect. But it is fairer to let the author sum up:—"The alleged protective coloration is not the all-important factor in securing an insect from extermination, as some earlier naturalists have supposed; there are other equally important factors that demand consideration."

An Entomological Exhibition.

PROFESSOR BOUVIER, of the Muséum d'histoire naturelle of Paris, announces that a great entomological exhibition is being arranged for in the laboratory of his department, and asks for co-operation. The preliminary prospectus, given in *La Feuille des Jeunes Naturalistes*, July 1899, is very attractive, and includes the following divisions:—Bees and apiculture; giant arthropods and giant nests; wasps' nests; classification and anatomy, with especial reference to flight and stridulation; reproduction and development; adaptations—defensive, such as mimicry and protective coloration—offensive, such as weapons—and in relation to change of habitat; commensals and parasites; social insects; bizarre forms; domestic forms; useful and injurious insects, and so on. It is a big undertaking, which well deserves the co-operation asked for. To see such an exhibition will be an entomological education in itself.

At Last?

A PAPER by Professor L. Errera, entitled "Hérédité d'un caractère acquis chez un champignon pluricellulaire" (*Bull. Acad. Roy. Belgique*, 1899, pp. 81-102), cannot but arouse the interest of evolutionists. Has the long-sought-for instance been found at last? Is there a modification in regard to which we can look the whole world in the face and say that it is transmitted? The story will be read with bated breath, as the advertisements of novels say.

Conidia of the mould *Aspergillus niger* were cultivated (A) in a Raulin solution, (B) in a Raulin solution plus 6 per cent of common salt for one generation, and (C) in the same for two generations.

Then they were placed in a Raulin solution plus 18·4 per cent of salt, in which A showed no germination, B slight germination, and C general germination; again, in a Raulin solution plus 6 per cent of salt, in which A produced spores in 5 days, B in 4 days, and C in $3\frac{3}{4}$ days; and again, in a Raulin solution without additional salt, in which A showed sporification in 4 days, B in 5 days, C in 5 days, but slight.

Spores from the last-named three cultures, in a normal Raulin solution, were then sowed in Raulin solution plus 18·4 per cent of salt, in which A′ showed after 5 days no germination; B′, after 5 days, just visible germination; and C′, after 5 days, clearly visible germination.

Hence, it is argued, that the conidia of *Aspergillus* become adapted to the medium in which their parent is growing, and more adapted after the second generation than after the first; and, as the adaptation to a concentrated medium is not wholly lost after rearing in a normal medium, there is evidently a persistence of the adaptation, an inheritance of the acquired quality of resistance to concentration.

In truth, however, this is not very convincing. The distinction between soma and germ-cells is not more than incipient in the mould in question; and even if it were more marked, what does the case show but that the germ-plasm may be affected *along with* the soma by a saturating influence, which nobody can deny.

We need more than this before we allege the inheritance of an acquired character. We wish to hear of a clear-cut somatic modification observed to occur in successive generations, and of the recurrence of this modification or of some change in the same direction in the offspring when these are reared in a environment from which the original cause or stimulus of the modification is absent. At the best, Errera's case is no more cogent than those which have been adduced from the study of alcoholism, where the germ-cells are apparently affected along with the body—cases with which Weismann has duly dealt.

We may, however, recall David Harum's words: "A reasonable amount of fleas is good for a dog—they keep him f'm broodin' on bein' a dog;" and re-interpret them, saying that a reasonable amount of such experiments as those of Errera is good for Weismannists—if so be they keep them from brooding on the perfection of their system.

Colours of Northern Monocotyledons.

Mr. John H. Lovell has arranged, according to their colours, the 1058 species of northern monocotyledonous flowers recognised in the "Illustrated Flora" of Britton and Brown, and finds there are 41 yellow, 82 white, 22 red, 22 purple, 34 blue, and 857 green or dull, the last set being of course enormously swollen because of the large number of grasses, sedges, and the like. It is useful to have the facts of colour-distribution clearly before us, and when we have this it is almost impossible to refrain from drawing inferences, which may or may not be correct. Those which Mr. Lovell has drawn (*Amer. Naturalist*, xxxiii. 1899, pp. 493-504) are the following:—

The primitive colour of the perianth of the monocotyledonous families was green, as it still is in the greater part of the species which are anemophilous or self-fertilised. A few of the oldest families, with an indefinite number of stamens and carpels spirally arranged, have probably never possessed floral envelopes.

Yellow, white, and lurid or greenish-purple flowers, have in numerous instances been derived directly from the primitive green; red flowers have passed through a yellow or white stage; and blue and purple-blue have been derived from yellow, white, or red forms. Reversion to white is most common, but reversion to red or yellow also occurs.

Physiological conditions appear to have often played an important part in determining the coloration of the petals, while "insects have contributed to the fixation of such characters when once acquired."

In general, among monocotyledons yellow flowers are visited by bees and flies; white flowers by bees, nocturnal lepidoptera, flies, and beetles; lurid-purple by flesh flies; red by bees and butterflies; and blue chiefly by bees. Red and blue flowers usually have the honey concealed, which is a far more effective cause of the limitation of insect visits than colour. When the honey is abundant and exposed, and the flower pleasantly odorous, it may prove attractive to any anthophilous insect.

The Proper and Improper View of Heredity.

We are not aware of the specific diagnosis of the journal called *The New Age*, edited by S. C. Mukhopadhaya, M.A., and published in Calcutta, but we know that it has a larger circulation (guaranteed) than *Natural Science*, and we see very prominently on its title-page an advertisement of a firm of plumbers and gasfitters, to which, indeed—unless to its position above the title—we have no objection, for the

association of science and art is one of our dearest ideals. We are afraid, however, that our mineralogical colleagues might not like the make-up of this "journal of universal information," for in the number before us the 5th heading is mineralogy and the 6th is science. It was an announcement under the last heading that arrested our hungry eye—"The Proper and Improper View of Heredity"—for this went beyond our furthest ambitions. We had cherished an idea that, with the help of Galton and Weismann and their opponents, we might in the course of time arrive at a discrimination between the true and untrue view of heredity, but the criterion of propriety seemed unattainable. We wondered before we opened the pages what revelation might await us—an exposure of Pearson's prolegomena as prurient, of Weismann's wisdom as wanton—and our fancies flew to Zola and Ibsen and other students of heredity, as we speculated whose views *The New Age* regarded as "improper." The very title, we say, was a wonderment to us. We had never thought of looking at the facts in the light of propriety, and yet how luminous it is! But when we came to the article we found only a feeble protest against the old, absurd misunderstanding that to recognise one factor in life means a denial of the others. "Let us never fold our hands and say, because we have inherited a poor memory, a small order, poor calculation, or imperfect digestion and weak lungs, that we are fated by that inheritance and cannot overcome it." Thereafter followed some verses on "Heredity's Opposites"—*e.g.*, "Lowest sinner, highest saint, dull of wit and full of *plant*" (the italics are ours), ending with the appropriate words "curses deep."

Darwin's Doggedness.

IN the charming address which the veteran botanist, Sir Joseph D. Hooker, delivered on June 14, when Mr. Hope Pinker's statue of Darwin, presented by Prof. Poulton, was unveiled at the University Museum at Oxford, there are many little touches which vivify the picture which modern naturalists have of their master. The proof-sheets of the *Beagle* journal impressed Hooker profoundly, even despairingly, "with the genius of the writer, the variety of his acquirements, the keenness of his powers of observation, and the lucidity of his descriptions." In 1844 Hooker was shown confidentially a sketch of "The Origin of Species," and on his many visits to town he was habitually "pumped" after breakfast with botanical questions, the answers to which were deposited in bags or pockets that hung against the wall. "If I were asked," he said, "what traits in Mr. Darwin's character appeared to me most remarkable during the many exercises of his intellect that I was privileged to bear witness to, they would be, first, his self-control and indomitable perseverance under bodily suffering,

then his ready grasp of difficult problems, and lastly, the power of turning to account the waste observations, failures, and even the blunders of his predecessors in whatever subject of inquiry." As is well known, Darwin was wont to attribute his success to industry rather than to ability. "It is dogged that does it" was an expression he often made use of. He attributed his results to "the love of science—unbounded patience in long reflecting over many subjects—industry in observing facts, and a fair share of invention as well as of common sense." This is a famously modest self-estimate, but its psychological justice may be doubted, and it seems to us important to notice Sir Joseph Hooker's opinion. "In this retrospect he has, if my judgment is correct, greatly undervalued invention, that is originality or that outcome of the exercise of the imagination which is so conspicuous in every experiment he made or controlled, or in the genesis of every new fact or idea that he first brought to light." Truly it was fell doggedness.

Dispersal of Seeds.

AMONG many interesting notes in Mr. Clement Reid's "Origin of the British Flora" is a table of modes of dispersal of seeds, which may be quoted as follows:—Minute seeds readily moved by accidents of all sorts; those eaten or dropped by birds, most of which are destroyed while some remain uninjured; seeds passed in an uninjured state by mammals or birds; those transported by wind; those which cling to feathers or fur (*e.g.* in the cakes of mud which adhere to the flanks of oxen); those transported by water; those plants of which broken pieces grow, such fragments being carried on the legs of wading birds often to great distances. With regard to the transportation by water an interesting observation has reached us from Mull and Iona. It is said that thousands of apple seeds have taken root on those islands, the result of dispersal from the wrecked liner "Labrador." Mr. Reid mentions an interesting case of a dead wood-pigeon found by him in a chalk pit; its crop was full of broad-beans, all of which were growing well, though under ordinary circumstances they would have been eventually digested. As he says—"A pigeon would easily cross the Strait of Dover in half an hour, and in the days when raptorial birds and wild cats were plentiful many pigeons must have been struck down with their last meal undigested."

Reformed Nomenclature!

PROF. HERRERA emphasizes the impossibility of recognising organisms by their names under the present complicated system of nomenclature

in botany and zoology. No one can profit by the 800,000 names recognised by naturalists. For who can tell from the name anything about the nature of *Mormops megalophylla*, *Sphaeria sobolifera*, etc., etc. One cannot even say whether one is dealing with plants or reptiles, with crustaceans or zoophytes!

It seems then worthy of consideration whether we should not in current usage suppress the generic name, and leave it for the lists and treatises of specialists, whether we should not in current usage substitute for the generic title some composite term indicative of the class and family to which the organism belongs.

Thus all the names of mammals might begin with the syllables *Mammi*, and end with abbreviations indicative of the family. Thus we would suggest *Mammicanae lupus*, *Mammivespertae megalophylla*, *Mammileporae* or *Mammileporus cuniculus*.

If there are two equivalent specific names in the same family, one might add the complete generic name in brackets.

He goes on to suggest—

Avigallinae domesticus.
Reptilacertiae ocellata.
Piscipercidae fluviatilis.
Molluskhelicae aspersa.
Legumpapilliae sativus.
Insecticarabae auratus.
Echiniholothuriae regalis.
Arachniacariae scabiei.

Such a procedure seems to him easy and logical. The radicals Mammi-, Avi-, Crypto-, Insecti-, recall the sulphates, carbonates, ethyls, etc., etc., of the chemists; and would not vary in any important degree within a century. It seems the only way of securing a universal biological terminology, and besides saving an infinitude of time, it would conform to the mode of the exacter science of chemistry. Such is Mr. Herrera's suggestion. It should make the sticklers for terminology 'sit up.'

Science and Conduct.

THOSE who, taking an interest not only in science but in human conduct, desire to harmonise their conceptions of the one and the other, should not fail to study Prof. Münsterberg's recent volume on "Psychology and Life."[1] It is not light reading. As the author says in his Preface—"I do not want to entertain by these papers, I want to fight; to fight against dangers which I see in our public life and our education, in art and science; and only those who intend serious and

[1] Archibald Constable and Company. Pp. xiv. + 286. Price 6s. net.

consistent thought ought to take up this unamusing book." But it has all the charm of boldness, originality, and evident conviction. Whether we agree or not we are forced to think. There are, too, many passages which stimulate by their piquancy. Of the greatest possible happiness of the greatest possible number, "that discouraging phrase in which the whole vulgarity of a naturalistic century seems condensed," he asks, "is it really the source of inspiration for an ideal soul, and does our conscience really look out for titillation in connection with a majority vote?" Again in the essay on "Psychology and Mysticism" he says: "The telepathists annihilate the theosophists, and the spiritualists belittle the telepathists; and when the Christian scientists and metaphysical healers on the one side, the mind curers and faith curers on the other side, have spoken of each other, there remain few abusive words at the disposal of us outsiders."

The gist of Prof. Münsterberg's argument, so far as it can be presented in a few words, is as follows. Physical science deals with the phenomena of which it treats in terms of matter and motion; mental science devotes its attention to states of consciousness. The one leads to materialism, the other to idealism. Both are right within the limits of an ideal construction elaborated for specific ends. Both are utterly wrong if they seek to impose their special *isms* beyond these limits. In other words their final conclusion is scientifically valid but philosophically monstrous. Human life and conduct present abundant material both to physics and to psychology, material to be explained in terms of cause and effect; but "the interests of life have not to do with causes and effects, but with purposes and means; in life we feel ourselves as units and as free agents, bound by culture and not only by nature, factors in a system of history and not only atoms in a mechanism." This may seem to some a hard saying; nor will it sound less hard when it is urged that the real world of purposes and teleological ends in which we live is endlessly fuller and richer than that shadow of reality which we mean by physical and psychological existence. There are plenty of hard sayings in Prof. Münsterberg's book. But though we may not agree with some of his main positions which appear to us open to criticism, he knows quite well what he is discussing, he is trained alike in physics and psychology, he is well acquainted with the stock, and often cheap, arguments of the materialist, and he is a thinker whose thought is not to be lightly disregarded and brushed aside simply because it does not chance to be consonant with our own. Hence we commend his book to serious naturalists, who can spare some attention to human affairs, not necessarily for acceptance but at any rate for careful consideration.

ORIGINAL COMMUNICATIONS.

Some Considerations Concerning Symmetry.

By Professor R. J. Anderson.

Symmetry has so much to do with the order, form, and arrangement of parts in natural objects and figures geometric, that one becomes interested in its varieties, the causes of these latter, and the relationships that exist between them. There is involved also the question of asymmetry. Symmetry is the outward and visible sign of the resultant forces that fashion a body. There is no limit to the number of forms that may be assumed, but with certain kinds of symmetry one becomes more familiar than with others. Bilateral symmetry is one of these. Corresponding to a part on one side of a bilaterally symmetrical body there is a part on the other side, the parts thus appearing to balance one another like weights in scales. A three-legged table, or other utensil of a tripod nature, seems to suggest more completeness because of the greater steadiness. The four-limbed symmetry of the vertebrate, and the six, eight, ten or more legged insects, spiders, crabs, etc., are instances of the bilateral. Radial symmetry is to be observed in numerous organisms, *e.g.* many plants, sea anemones, and star-fish, and is commonly distinguished from the bilateral.

The sphere is the most generally symmetrical solid body. It is divided into two parts by any plane passing through its centre. The spheroid is divided into two symmetrical halves by every plane passing through its axis of rotation, and by the equatorial plane. The general ellipsoid can only be divided symmetrically by three planes. The right circular cylinder can be divided into two similar parts by any plane passing through the axis. The right elliptical cylinder can be divided into two equal halves by two planes only, passing through the axis, and the right circular and elliptic cones conform to this rule. If the cylinders and cones be oblique only one plane can divide those solids symmetrically. These are only special forms of the infinite number of possible cones and cylinders. The conceptions and practical investigation of complex figures gradually become impossible to all except

a few, and at last even to these. Yet even a superficial study of such figures and forms must lead one on to the consideration of the forces at work. There is exhibited on approaching the living form a remarkable feature which living things possess beyond inorganic forms, viz. the greater power and facilities which a living organism has to express what it cannot conceive or understand, and the capacity of adjusting most complex forces to meet others which it can neither measure nor weigh.

The forces that are at work in moulding bodies are external or internal; amongst the latter may be placed surface tension in fluids. The external compression that causes a soft substance to assume a spherical form is more familiar to us than the mode of action of the cohesion forces that cause the particles to swing into position to form the crystalline body. Yet one may in inorganic bodies see that the forces that press, or the pressure that acts all around a sphere, may be so distributed as to form a cube, if divided into three equal pressure sets, each two forces acting opposite to one another on equal areas and at right angles to the directions of the other two pairs. The cube, octohedron, or dodecahedron (with rhombic base), may be easily produced by similar compressions, and these symmetrical irregular bodies may be divided into two equal symmetrical parts by three planes or more passing through certain axes. It is evident that a quadrilateral symmetry may be noted in a cube lying on one side, by making sections with suitable planes, and a triangular symmetry in sections made perpendicular to a through diagonal. A suitable adjustment of the compressing forces leads to the production of the square prism. The side pairs of pressure sets will in this case be equal, whilst the end pair is greater or less, but each pressure pair acts at right angles to each of the other pressure pairs. The lateral compressing forces, if one opposing pair do not act at right angles to the other opposing pair, will give rise to a rhombic prism. The three main axes must stand at right angles. If the compression be so applied that an oblique prism is produced, one plane only can be found which will divide the crystal into symmetrical halves. Where a crystal is doubly oblique, the form may be imitated by proper pressure planes, no plane of symmetry can be found; symmetry here is only discoverable in individual planes. The hexagonal prism form seen in beryl and other minerals is connected with the rhombohedron, and the rhombohedron is a cube crushed out of shape. The tetrahedron and pentagonal dodecahedron are asymmetric crystalline forms, although regular solids.

Angular bodies are not limited, as is well known, to inorganic nature. The elements of which organic bodies are composed are often constrained to assume forms with an angular outline. Polyhedra, hexagonal prisms, tessellated pavements, brick shaped and stellate cells, are a few of the varieties well known to the student. These forms, although correctly attributed to external pressure, are largely under the influences of forces inorganic and organic within the elements themselves.

It is evident that a limit to the exercise of the compressing force may be set by the elasticity of the cell contents resisting any further compression, or extreme pressure may paralyse the cells. Then light, heat, and electric phenomena, as well as gravity, are agents that may influence the demeanour of the cells. The radiate symmetry of a hexagonal prism body or element is easy to understand, but the prism may be divided bilaterally by six planes that pass through the axis, and notably by three directed through the axis and opposite angles. Skeletal structures laid down along the lines of certain radii, where circumstances favour the deposit, establish the character of the symmetry, and these radial structures (composed of lignin, lime salts, cellulose, or other substances) leave between them avenues which protoplasm and fluids keep free. The skeleton, like many another tissue, is advantageously regarded as an excretion, such as might be cast off by some organisms, but is retained by its possessor. This structure, of seeming advantage at first as a protecting and supporting framework, grows so large sometimes as to interfere with the activity of the tissue by which it has been produced. There are apparently no limits to the possibilities in the interior structure of cylindrical organisms. The number of radii may be many or few, and the cylinder may be of small or large diameter.

The trimerous and pentamerous symmetry of plants excited much interest when first established as a plant law. The fixity and nature of growth of the higher plants favour a radiate cylindrical symmetry.[1] There are well-known cases of an apparent bilateral symmetry, in the ovary and other parts, and a spurious quadrilateral in others. The increase in information with reference to the effects of light, heat, gravity, etc., forces most people to be cautious in drawing conclusions. Dr. William Allman, formerly Professor of Botany in the University of Dublin, sought to connect the structure of exogens with the pentamerous arrangement of the parts of the flower, and that of the so-called endogens with the trimerous arrangement, by means of the cellular structure of the plants. Starting with the hypothesis that plant-cells in mass have a tendency under the influence of an all round pressure to assume figures intermediate between the sphere and regular solid, he refers to the fact that the regular solids are: the tetrahedron (4 sides), cube (6 sides), octohedron (8 sides), dodecahedron, with pentagonal faces (12 sides), icosahedron (20 sides). He proceeds to show that the two latter forms appear to agree best with the forms of cells in plants, the dodecahedrons would best explain the pentagonal arrangement of the exogens, and the icosahedrons the trimerous form of endogens. The cubical form was regarded as more prevalent amongst the acotyledons. Allman supposed the young shoot of a

[1] The term symmetrical is used sometimes by authors when bilaterally symmetrical is meant. The word is also used to indicate certain relationships between sepals, petals, stamens, etc.

plant to consist of columns of dodecahedral cells, arranged so that the upper surface of one cell might coincide with the base of the one next above it. If the adjacent columns fit as nearly as possible into one another, that is to say, that the re-entrant angles of one column may correspond to the salient angles of the other, three dodecahedra will meet at each edge, but, since the angle of a dodecahedron is less than 120°, they will not fill the space, but will leave interstices, increasing in width from the centre of the mass towards its circumference. The "tubes" will find room to grow in these interstices, and the growth will be effected by the addition of matter externally as in exogens. The increase is likely to be more considerable where the edges meet, that is, at the angles of the pentagon, than elsewhere. Certain qualifications are, however, introduced. If the cells are icosahedral and arranged in the same manner, it is easy to see that, their angles being greater than 120°, the interstices would be formed internally, and that the growth of such a plant would proceed by the internal addition of matter as in so-called endogens. In this case, as in the exogens, the growth should take place along planes passing through the angular points. Hence the parts ought to be arranged in threes in the one case and in fives in the first. The parts in the fructifying organs of certain fungi and mosses are in number powers of two, so, it is pointed out, that the cubical arrangement in acotyledons is rendered probable.[1] This ingenious hypothesis ("Une idée au moins piquante et ingénieuse," says De Candolle) was propounded in the earlier years of the present century. The elements, although angular, unite to form tissues with round outlines. The form assumed is the result of various forces. Equally diffused pressure acting along the radii of a cylinder tends to maintain its form. A cone would have its shape best maintained by the diffusion of the pressure according to a certain law; but here again the internal activities, surface tension of cells, perhaps, and other agents, may materially modify the results.

One cannot venture to compare the increase in size of a crystal to the deposit of a soluble salt from an evaporating solution, but rather to the growth of a battalion of soldiers by more men falling into rank all round at the word of command. Even in crystals many are the causes that affect the increase in size and form; temperature and impurities in the substance are two of the best known. The "growth" here is, of course, influenced by the supply of material. Organic bodies, also, are influenced by many activities that start from without and reach into their substance. Their growth is true growth, but within considerable limits the physical demeanour of the organic may correspond to the inorganic.

One might compare a slender shoot to a six-rayed ice crystal that is growing slowly by the addition of an upward stream of water.

[1] Abbreviated from Allman's paper. The term "tubes" appears to have been used to indicate vessels and fibres of plants as distinguished from cells proper.

The flow of nutrient fluid in the plant conjoins with the active protoplasm to make new tissue. Year after year new additions are added to the stem, but these are laid down in accordance with the laws of plant growth. Whatever may be the resolution of these forces, it is evident that the form, shape, and nature of the grouping of bundles, and the succession, as well as the shape of the conjoined bundles and packing tissue that form stems or leaves, are the results of not merely internal forces, physical and organic, but external forces of great constancy, if not of great magnitude.

A collapsing cylinder is said to assume often the form of a three-sided prism, and a sphere the form of a tetrahedron. There can be no harm in placing side by side with this statement the record of trimerous symmetry in plants. One would require to take a note of several hollow cylinders in the latter case, perhaps, which renders the comparison more difficult; five, six, or eight-angled prisms might also be allowed to be within the powers of plant manufacture,—columns not to be formed as a battalion of soldiers, from the outside alone, but by the addition of new rows between the already formed lines. W. Allman pointed out a connection between the icosahedron and dodecahedron; if the latter be inscribed in a sphere, tangent planes at the angles will constitute an icosahedron, just as a cube in a sphere similarly treated will give rise to an octohedron, and a tetrahedron to a figure like itself. It may be noted here, that, if we compare the pentamerous symmetry with the trimerous, it will appear at once that five equilateral triangles [1] meeting by their apices and arranged so that each is separated from his neighbour by twelve degrees, will leave chinks which in triangular prisms would serve for young tissues. Account is rather taken here of the collective tissue groups (vascular and cellular). The flower or leaf parts, if followed to the large stems, are not so easy to marshal. Six equilateral triangles meeting in the centre by their apices, and lying in the same plane, would leave no spaces for the reception of cells or fibres; in this case the exterior of the composite bundle might be regarded as the chief generating tissue. Then eight equal equilateral triangles with the apices turned in would require to stand well out in the same plane in order that their external angles might even fit to one another. Eight equal equilateral triangular prisms may be adjusted, with their long axes parallel to one another, and with their edges on radial planes that divide the cylinder into equal segments. One face pointing out in each, and one edge looking in, will, if the prisms stand, leave interspaces internally wide and externally narrow. These prisms, if the first to develop out, might determine the course of future tissues. The arrangement of the leaves on the stem suggests other schemes for plant bundles, but there is clear enough proof of a predominant radial symmetry, and it does

[1] The triangles are here taken to represent sections of prisms. No account is taken of any twisting the stem or bundles may experience in the course of development.

seem odd that the two forms of prisms that the trimerous and pentamerous symmetries suggest are asymmetric. The fact that arboraceous monocotyledons dwell in the tropics, and that dicotyledons dwell in temperate regions, has been commented on. The Dicksonias of New Zealand and the araucarias of South America have chosen curious places for homes. The sun in rotating on its axis, in sending its rays through an atmosphere that partly polarizes the rays which are going through the air with various degrees of obliquity, and the same luminary in having its countenance affected by spots occasionally, not to speak of the various wave whirls that may affect rays going in different directions, may be held responsible for some of these discrepancies. The rays, if they are of such a nature as to be alterable by a crystal, may be naturally expected to have some power to alter the character of a crystal, or other substance, and so a crystal may get a molecular twist, and the plant that uses the crystal as food may become similarly influenced, or get directly altered itself; but although there may have been a tendency to molecular twisting in the young plant by the sun's rays, grown plants are not so apparently affected; the plant tissues seem to have some power of correction, and so the difference in the effects of the symmetry of the rays in the north as compared with the southern hemisphere is not observed.

The symmetry of animals is of various kinds. The spherical kind is illustrated in the Protozoa. The Radiolaria, with their rays and their trellis work, show us what was, or is, being done, and raise inquiry as to the various agents that may be at work in bringing about the result. Still water or some inert fluid may be looked upon as favouring the maintenance of the spherical form seen in the resting stages of many Protozoa, but the surface tension may also contribute largely to the result. The sea anemones, simple sponges, and corals are admirable examples of the modified cylindric symmetry; the medusae illustrate the modified spherical symmetry. The mouth in the centre with appropriate radiating tubes, and in some cases the actual provision of separate segments with a definite nervous system, shows a very important departure in the bearings of the symmetry of a body on its life. The welfare of many an animal is so much connected with its colonial habits that its separation often means rapid extinction. The chance of extinction is diminished by the segmentation in question. Each part is, in a manner, independent of its neighbours; so are the parts of a star-fish, which may live after separation. A single ray may even turn over. A mechanical advantage seems also to be derived from a pair of fixed planes placed at right angles to one another, both as regards purchase and security, in the case of certain medusoids. The rhythm of *Rhizostoma* seems independent of the symmetry, 20 to 24 contractions per minute in a closed vessel were noted in one case. The rhythm is best counted in the sea, however, an operation which is only possible there in some medusae. The motion of the fluid from centre

to circumference may in part be responsible for the radiate character of the tubes, but the other forces already alluded to in other structures cannot be lost sight of in this connection, nor the fact that the contraction and dilatation of the umbrella favours the circulation of fluids in certain directions.

Passing over the tunicates, which may be radial in colonies and bilateral in individuals, the worms, arthropods, and vertebrates may be noted. A bilateral symmetry is here evident enough. Not only in the early forms, but in the adult life of many of these and molluscs, a disguised radiate symmetry seems to prevail.

The chief axis of the yolk sac in the chick may be regarded as an axis of symmetry in the young animal. There may or may not be the remains of an apparently azygous organ, but a radiating system of alimentary tubes is easy to see in some animals, and a like arrangement in the nervous and vascular systems in others that are easy to group with a central axis. The paired ganglia above and below the anterior part of the alimentary canal in worms and arthropods, and the three pairs of ganglia in the molluscs, may also be regarded as an exaggerated radiate symmetry. Then the alimentary canal has been looked upon as forming the central axis of the system, an axis often strengthened by lime or chitin, deposited or formed in a tissue derived from without; the cells also that form bone are probably derived from the outer embryonic cell layer. The vascular system consists chiefly of four tubes in some worms (dorsal, ventral, and lateral). The nervous system may occupy the sides in the central part of the body, or dorsal and ventral cords may be both present in the same animal. This bilateral symmetry might be regarded as a modified kind of quadrilateral symmetry. The special development of certain parts emphasizes the former variety. The dorsal tube feet in some holothurians are dummies, whilst in others are three rows of tube feet on the ventral surface, and two on the dorsal. There are indications of a bilateral symmetry in the interior. The enamel of the teeth is derived from a portion of the invaginated skin in the vertebrates; so, if, passing over the early stage, it be desirable to take the alimentary canal as the axis of symmetry, some ingenious attempts may be made to give force to the assumption. The position of the primitive mouth will not then escape attention, nor will the fact that the sympathetic has a good district in the alimentary canal. If this study be pushed as far as one can decently go, and the ground changed to the spinal canal and cord, then a most instructive method of comparison may be noted, viz. on the dorsum a canal, a nervous cord around it, and the appropriate serous membrane, blood vessels, muscle, and bone; and, on the ventral part, the intestinal canal, a sympathetic neuro-muscular system, serous membrane, vessels, etc.

Around the vertebrate axis a modified radial system seems to prevail. Owen and Humphry advocated this, although not in so

many words. Owen's typical vertebra, it will be remembered, has growths above, below, and at the sides. The two dorsal growths end in the spine; the lateral growths are the transverse processes (dorso-lateral), and the lower growths (ventro-lateral) may join the ribs which form an arch like the dorsal one. The limbs are represented by diverging appendages. The limb folds seem to partake of the quadrilateral symmetry type in some fishes. Humphry pointed out that the term "duality" is inapplicable to the nervous system and skeleton. The lineal axis of the embryo sends off the processes referred to, and there is therefore a quadrilateral rather than a bilateral symmetrical arrangement.[1] Humphry, however, distinguished between the body as a whole in this regard and the separate parts. Leaving out the bodies of the vertebrae which are variously formed, but originally developed round an endodermic growth, one can make out a radiate symmetry of four, five, or six rays, according as certain processes are counted or omitted. The pillars of the dorsal arch may be counted separately, so may the transverse processes and body processes; or, reckoning each pair as one process forming a two-pillared arch, there are four arches. The spinal nerve cord section occupies the dorsal arch, the sympathetic the ventral, and the posterior root ganglia are at the sides. It is clear, however, that the spinal cord may be looked upon as made up of two lateral halves, so may the sympathetic cords. A survey of the entire system tends to render the bilateral symmetry of each less clear, whether taken together or separately. The sympathetic seems to be of more considerable relative importance in early life, judging from the drawings of Paterson. The ganglia are often large in man, but the size appears to be due in the abdominal ganglia to fibrous tissue (D. J. Cunningham). W. Alexander has removed the superior cervical in man with advantage to the patient, proving how far the system has gone back.[2] The sympathetic is, however, of enormous interest because of its distribution, subsidized by the spinal, in the viscera and arterial coats. The symmetry that takes account of the spinal cord, divided into two equal lateral parts, has also reference to the division of the abdominal nervous system, so that a modified quadrilateral symmetry may appear as a bilateral symmetry. The dorsal and ventral systems, as every one knows, are mainly independent of one another. The presence of the serous membranes secures this independence in part, but the nerve connections do not favour a ready transference of impressions from one system to the other. The connections, however, come into use often in disease, and a slight activity in the terminals of either systems, may produce a profound disturbance in the district supplied by the other. The sympathetic ganglia associated with the cerebral system are obscured by the magnitude of the large brain and its connections in vertebrates. The

[1] See Quain's "Anatomy," 8th ed.

[2] Nerve cells being now proved to be trophic only, the fibres collectively assume more prominence in our estimate of the value of a nerve tract, or district.

significance of some of these ganglia has been satisfactorily learned. The sense organs bear out apparently the statement that vertebrates are, speaking generally, bilateral animals. The pineal eye, and the arrangement of the sense organs in some invertebrate types, may be cited as being favourable to other views of symmetry. It will be remembered that C. S. Minot thinks that the cerebral ganglia of a worm may fairly be regarded as the optic central organs, and that some of the suboesophageal would do for cerebral ganglia if the mouth were further back.

Asymmetry.

The five fingers and the five nerves that form the brachial plexus have been associated by some anatomists (Paterson), but Bardeleben has given reasons for regarding the primitive hand as having a much larger number than five digits. The Gasteropods show rare examples of asymmetry. The left respiratory organ and the left kidney in part lose their character, and the right organs do the work of the pair. Mechanical causes seem to be the main agents in bringing about the absorption of the absent organs. A superficial bilateral symmetry appears in some, but not only is there want of dorso-lateral symmetry, but the dorsal growth of the animal has been so considerable, and the form has become so altered dorsally and ventrally, that with the exception of a portion of the body in front, it is impossible to see an approach to quadrilateral symmetry. There are, however, the four ganglia or six, which may be looked upon as part of a radial quadrilateral or hexagonal symmetry. The renal organs of the lancelet are sometimes asymmetric. The newly-hatched sole is symmetric; the size is 3·55–3·75 mm. long. This creature swims with its yolk sac up because the latter is light (Cunningham). The eyes come to lie on the upper surface (the right). Remembering that if a fish is to forage and rest on the floor of a bay, it must be spread out laterally or have some supporting apparatus in connection with its fins, it seems natural that the sole or plaice, not being able to make suitable provision in either of these ways, should simply lie on its side and turn its second eye up. The result is advantageous in this way, that a surface of one to two square feet is presented to the view of a voracious dog-fish, skate, or shark, so that the apparent size may save the sole or plaice. The asymmetry is, therefore, susceptible of a triple explanation. The diminution of one lung in snakes is due to the elongation of the body; with the elongated lung a certain amount of dislocation of the viscera is associated. The single lung is, under the circumstances, better suited for respiration. The single ovary in birds is most convenient in consequence of the large eggs, and the large ovary is connected with the persistence of the abdominal rather than the chylopoietic aorta. The latter is, evidently, the best for mammals. Asymmetry in the dolphin tribe is marked in the skull. The large left upper canine

tooth of the narwhal emphasizes the condition. This asymmetry is not easy to explain. Is it due to the dolphin opposing one side by preference to an ocean current, so that he grows gradually one-sided, like a sensitive politician? or does he get altered by attempting to present a too bulky broadside to an opposing foe for the purpose of increasing his self-importance, or to reassure himself? May the change have been brought about as the result of deep nervous impressions received from without? This creature lives near the surface a good deal, and sees much that is one sided among the phenomena of aerial nature. The contemplative disposition may allow the reflex nerve actions too much range.

The well-known cases of asymmetry in man may be mentioned—the left aorta and heart, right sided liver, left stomach and spleen, large right lung, the lateral spinal curve. The viscera may be transposed in position. Asymmetry is found sometimes in the muscles of man. The chest region may display asymmetry, the sternum or ribs may be more prominent at one side. The pelvis also shows occasionally some features of asymmetry. The skull, in the size and thickness of the cranial bones, is subject to some variations. The bones on one side are sometimes thicker than those on the other side, as has been shown by the writer elsewhere; the sinuses of one side are sometimes larger than those of the other. The septum of the nose is often bent to one side. Bilateral symmetry in man seems to be the rule. Humphry laid much stress upon this fact, but he takes occasion to refer to the specimen of a skeleton of a boy in the Bonn Museum, in which the bones of the right arm and leg are longer than those of the left side. The disproportion was marked by nodules in the leg bones, but not in the arm bones. These nodules indicate the former presence of inflammatory action in the right lower extremity. The right humerus is 9 lines and the ulna 10 lines longer than those of the left side. The right femur is 11 lines, and the right tibia 2 inches longer than the left ones.

The nervous system has considerable influence over distant parts within certain limits. Asymmetry is thought by some to afford some indications of permanent central nervous change. Abundant statistics are necessary in order to come to any satisfactory conclusion. Lombroso found in one class (Class A) of offenders 26 per cent of cranial asymmetry; in Class B, 46 per cent; Class C, 32 per cent; Class D, 50 per cent. Asymmetric faces were found in 7·7 per cent of delinquents and in 1·8 per cent of another class. Criminals have the advantage (?) of others in possessing a larger percentage of wry noses (not due, presumably, to mechanical causes). Asymmetric faces are commoner in classes B and D than in other types. It is also stated that anomalies are more common in man, especially savage man, than in woman, and more common amongst males of other vertebrates than in females (Viazzi quoted by Lombroso). It will be remembered,

however, that anomalies are more common in man than in other mammals. In the latter anomalies of all kinds are rare. The production of a deformity, owing to some peculiar mental state, is not easy to follow out. There are very many factors at work. The mental and physical defects may be concomitant effects of the same cause, or the latter may be very remotely connected with the former. A deformity, if exposed, is, on the other hand, not necessarily associated with any aberrant mental condition. A structural change in the central nervous system may be associated with some distal change, but the distal change may be due to easily explained mechanical causes.

If we revert to asymmetry in crystals, it will be recollected that attempts have been made to explain their asymmetry in their action on light, by referring to the asymmetric character of solar radiation. Some crystals rotate the plane of polarization to the right, others to the left, and two opposites are compared to a pair of gloves. The sun's rays, passing south (as has been noted earlier in this paper), may be expected to produce effects on vegetable structures different from those produced by the north-going rays or the intermediate ones. The question of the effects of the sun-spots arises naturally. If these asymmetric rays and the portion of the solar surface exposed has favoured the growth of dicotyledons in one place, monocotyledons of great dimensions in another, and giant ferns in a third, what is to prevent our speculating on the changes that may have resulted from certain alterations in his demeanour in ancient times? Did the sun show less or more of one pole to the Silurian world? Was this followed by a bend that gave rise to the vegetable products of the carboniferous? Was another change attended with the growth of the Triassic, and another with the growth of the Jurassic flora, until at last, after a tropical and cold period, the present temperate vegetation of the north, and the palms in the tropics and Dicksonias in the south, have been evoked by some new position of the solar globe?

In special breeds of domestic fowl abundant material can be obtained and the history can be studied. The sternum is often marked by a crooked keel, and the tail-bone and feathers are sometimes wry. The bend of the keel is sometimes to the left and at other times to the right. A large number of specimens have been examined, but taking fifteen at random, there is a distinct bend to the left in nine keels and to the right in six. Tracing one of the best marked, the keel at the anterior part is seen to be a little bent to the right, followed back it leads to the left, crosses the middle line, forms a curve of considerable length, and, turning in to the median line, recrosses it to the right side.

Two-thirds of the breeders consulted by me are of opinion that crooked sternum keels are hereditary, and that in-and-in breeding is accountable for the wry tails.

One-third of the breeders consider the causes to be mainly

mechanical and due to the nature of the roosts. These breeders look upon the weakness naturally associated with the preparation of pure breeds of fowls as a predisposing cause.

Light pure bred fowls have been often observed to have crooked keels, whilst heavy breeds, if the birds are not allowed to roost early, have not the deformity. The following is a note from a breeder:—" A 'black Norfolk turkey' with a crooked breast was mated with a straight-breasted hen. All the chicks got the same treatment, the roosts were low and flat, and covered with straw until the birds were able to fly." Notwithstanding these precautions five cock birds out of the sixteen birds which formed the flock had crooked breast keels. Water-fowl have sometimes crooked breasts; the deformity here is not due to roosting. The most crooked sternum in my possession belonged to a Brahma. The keel, where the bend is greatest, is nearly horizontal. There are marks of pressure on the keel edge in some cases. A distinct broadening of the edge of the keel is perceptible, in two bent to the right, and in four bent to the left. An indentation occurs in front of the middle of the two keels bent to the left. Two keels have marks of having been broken and reunited. The wry tail has been attributed to the bird roosting too near the wall, and to the tendency to form a compensating bend in consequence of the breast being bent to the opposite side. The fanciers who believe that it is due to inherent weakness because of the breeds being run out, seek to correct the tendency by the introduction of new stock. The wry-tailed birds are discarded. The evidence goes to prove that—

(1) Malformation is commonest in pure breeds.
(2) In-and-in breeding tends to develop wry tails and crooked keels.
(3) The distortion is frequently transmitted from parent to offspring.
(4) Roosting on round or sharp roosts tends to promote the distortion.

Summary.

(1) The shape of a body may be due to forces within or pressure without, or both.
(2) The same kinds of symmetry are to be observed in inorganic and organic forms.
(3) The forces at work inside organisms are "vital" and physical. The resultant figures are the expression of the work of two or more sets of agents.
(4) Asymmetry may be due to causes internal or external, or both.

I have to thank Dr. G. J. Allman for the opportunity of consulting his father's manuscript.

QUEEN'S COLLEGE,
GALWAY.

The Flora of the Alps.

By Professor Alfred W. Bennett, M.A., B.Sc., V.P.R.M.S.

Even to those tourists who claim no botanical knowledge, the pleasure of a visit to Switzerland is greatly increased by the extraordinary beauty and variety of its flora. Even in the lowland valleys and on the spurs of the foot-hills, the wild plants, if not more varied and more beautiful than our own, present many novelties, at least to the dwellers in our southern counties. In the early spring the meadows are gay with the globe-flower and the bird's-eye primrose; later on the monks-hoods, yellow and blue, the hellebores, the anemones, the phyteumas, the pinks, the gentians, the yellow foxgloves, have the charm of novelty; and the keenest delight is experienced when the blue bells of the Soldanella are first seen peering through the snow, or the Edelweiss is first gathered in its rocky home. It is only the experienced botanist who realises that, as a compensation, some of our most beautiful wild flowers are absent from the flora of Switzerland. We can well understand the rapture with which the great Swedish botanist Linnaeus is said to have gazed for the first time on a gorse-common in full bloom; for the gorse is not abundant in Central or Northern Europe. Our bell-heathers hardly go east of the Rhine, and may be said to be replaced on the Swiss mountains by the "alpine roses" or rhododendrons. The wood-hyacinth and the purple foxglove are not found in Switzerland.

The distribution of the alpine flora in Switzerland is very unequal. The calcareous Jura has a subalpine flora of its own. The flora of Mont Blanc and of the Alps of Savoy is a very poor one. That of the Bernese Oberland is somewhat richer. But the great wealth of the alpine flora is south of the Rhone valley; and especially in those mountain spurs and alpine valleys which stretch into the territory which is geographically and linguistically, though not politically, Italian. The Rhone valley itself exhibits a remarkable commingling of different floras. Here I have gathered, almost side by side, the subalpine holly-fern (*Polystichum lonchitis*) and the gigantic horsetail (*Equisetum ramosissimum*) representative of the Mediterranean flora.

With regard to the special characteristics of the flora of the Alps,

the most familiar and most striking is the abundance of the flowers, growing either in great masses or remarkable for their large size and brightness of colouring. This is exhibited in various ways. In the first place, we may compare the alpine with the lowland species of genera which are represented in both floras—for example, *Aquilegia alpina* with our columbine; *Dianthus alpinus* or *glacialis* with our pinks; *Scutellaria alpina* with our skull-cap; *Bartsia alpina* with our British species; *Myosotis alpestris* with our forget-me-nots; the Edelweiss with our cudweeds; and many others that might be mentioned. Or we may take genera that are exclusively or chiefly alpine, as far as the European flora is concerned:—*Gentiana, Primula, Pedicularis, Rhododendron, Soldanella, Saxifraga, Sempervivum*, etc. These are among the most familiar glories of the alpine flora. Or, again, we may take genera common to high and low altitudes, but in which the alpine species are characterised by the small flowers being so crowded together as to make the masses of them very conspicuous from a distance, such as *Arabis, Silene, Moehringia, Draba*, and many others.

The advantage to alpine plants of the conspicuousness of the flower is obvious. Although not so dependent as lowland plants on the production of seeds for the perpetuation of the species—the great majority of them being perennials—yet, like many of our own perennial plants, trees and others, they do, as a rule, produce abundance of ripe seeds, and for the carriage of pollen from the anthers to the stigmas they are largely dependent on the visits of insects. Now, at great altitudes winged insects are comparatively scarce, and it is obvious that a conspicuous and far-seen sign as to the locality where they can find their honey must greatly increase the number of flower-visits which they can pay in the course of a sunny afternoon. Mr. G. W. Bulman has recently, in the pages of this journal,[1] ventured the opinion that four of the keenest-sighted naturalists who have ever studied the phenomena of plant physiology—Darwin, Wallace, Lubbock, and Hermann Müller—are all mistaken in their interpretation of the function of colour in flowers, and that insects are attracted to flowers mainly by the sense of smell rather than by the sense of sight. My own observations, which have extended over many years, lead me to range myself unhesitatingly on the side of those distinguished names. That insects are, to a certain extent, attracted by the odour of flowers is undoubted. But in the Alps this can only come into play to a very subordinate extent. Very few alpine plants are strongly scented; and, if they were, owing to the strong winds that almost constantly prevail at those great heights, the scent would be almost useless in indicating its source to insects. In the bright colour and large size or close crowding of the flowers, we have, on the other hand, an obvious and admirable adaptation to this end.

But it does not by any means follow that the sole purpose of the

[1] *Natural Science*, Feb. 1899.

bright colour of flowers is to attract insects. We find it in flowering plants where it can have no such function, as in the scarlet stigmas of the hazel, which is unquestionably anemophilous, and in the young inflorescence of the larch; or, in Cryptogams, more especially in connection with the organs of reproduction, as in the brightly-coloured oogones and antherids of *Chara* and the red sporanges of *Sphagnum.* There can be little doubt that the bright red colour has an important function in absorbing and retaining the heat-rays, and thus maintaining the organ at a temperature necessary for the physiological processes going on within it. Hence the very earliest of the flowers of the Alps, like Soldanellas and Hepaticas, are usually very brightly coloured, and the earliest spring foliage has also very commonly a more or less bright red tint.

There are other and equally interesting characteristics of alpine plants. And here it may be worth while to contrast the conditions of life in high altitudes and in high latitudes, which are often assumed to be very similar. They are, in truth, totally different. In the arctic or subarctic zone we have a brief summer, during which there is almost perpetual insolation and a nearly uniform temperature throughout the twenty-four hours; in Switzerland the summer nights are longer than they are with us, and the difference of temperature between day and night is often excessive, the nights being associated, even in the height of summer, with exceptionally heavy dews. It will be seen, therefore, that we have totally different climatic conditions to deal with. We have in our own flora several arctic species which do not occur in Switzerland, as, for example, *Saxifraga nivalis* and *Primula scotica.*

Alpine plants have several other characteristics besides the large size or close crowding of the flowers. In the first place, although many ripen abundance of seed, but a very small proportion, as has already been mentioned, are annual. In many the floral organs are almost completely formed within the flower-bud during the preceding autumn, so that they are ready to unfold with the first warm days of spring, and before the appearance of the leaves, not requiring these organs to supply them with any further food-material. Hence the very early flowering of many alpine and sub-alpine plants, such as the hepatica, Christmas rose, winter aconite, species of *Soldanella, Primula, Gentiana,* etc. Secondly, from the great strain to which they are subject from violent winds, we find a considerable number with prostrate woody stems, species of willow, birch, etc., such as we seldom meet with in plants of our own climate. For the same reason the root-system is also often very strongly developed in comparison with the aerial part of the plant. Furthermore, the extreme brightness of the sun during the summer months has a tendency to cause excessive transpiration or evaporation from the leaves, which has to be counteracted by specialities of structure. This protection is afforded

in many ways. In some the leaves are thick and fleshy, as in species of *Sempervivum*, *Pinguicula*, etc.; or they are crowded together in dense rosettes, as in so many members of the orders Cruciferae or Caryophyllaceae. Others are covered with a dense felt of hairs, as in species of *Achillea*, *Artemisia*, or *Gnaphalium*, including the Edelweiss. In others again protection is afforded by the rolling back of the margin of the leaf, as in *Azalea procumbens*, *Empetrum nigrum*, etc. The greater rarity of the air at high altitudes implies, of course, a smaller supply of carbonic acid gas from which to build up the food-materials of the plant. Hence the organs in which alone this manufacture of food-materials can take place, the green leaves, are almost invariably strongly developed.

In a very interesting series of experiments carried on by Prof. G. Bonnier in his experiment-station at Fontainebleau,[1] he appears to have established the fact that it is possible to produce artificially the special characters of alpine plants grown in the open air, by subjecting lowland species to alternations of temperature comparable to those to which plants are subject at high altitudes. He took a number of familiar lowland plants,—*Trifolium repens*, *Teucrium scorodonia*, *Senecio jacobaea*, *Vicia sativa*, *Avena sativa*, *Hordeum vulgare*,—and, choosing in all cases specimens springing from the same stock, grew them in three sets: the first set was kept continually at a low temperature—4°-9° C.; the second was grown under the normal variations of temperature in Central France; while the third set was subjected to very low night temperatures, and to strong insolation during the daytime. As a rule he found that in the third set the subterranean parts of the plant became more developed relatively to the aerial stems; the latter became shorter from an abbreviation of the internodes, more procumbent, and either more woody or more hairy; the leaves were smaller, more fleshy or more hairy; the flowers were produced at an earlier period, and were relatively or even actually larger, and were more brightly coloured. The internal structure of the leaf showed corresponding changes:—the epiderm was less strongly cuticularised; the palisade-tissue became relatively more important; and, in the same leaf-area, the function of chlorophyllous assimilation became more intense. If, as would appear from these experiments, the anatomical and morphological characters of alpine plants are the direct outcome of a response to external conditions, and if these characters are perpetuated from generation to generation, this would seem to afford strong evidence of the non-universality of Weismann's law, that acquired characters cannot be transmitted by heredity.

The number of species of which the flora of the Alps is composed varies, of course, with the view entertained by the botanist of specific limits. The late Mr. John Ball, president of the Alpine Club, the

[1] *Ann. Sci. Nat.* (*Botanique*), vol. xx. 1895, p. 217; *Comptes Rendus Acad. Sci. Paris*, vol. cxxvii. 1898, p. 307.

highest authority, gives the number as 2010, divided into 523 genera, included in 96 natural orders. This is considerably richer than the flora of our islands, notwithstanding our extensive sea-board and great variety of soil and climate. A very few usually maritime plants are, however, found in Switzerland, as the thrift (*Armeria vulgaris* var. *alpina*) on lofty mountains, and the yellow horned poppy (*Glaucium luteum*) on the shores of Lake Neuchatel. Of these species 1117, arranged in 279 genera and 60 natural orders, belong to the upper zone of the Alps. The largest number of species occur in the orders Compositae, Leguminosae, and Gramineae, followed by the Cruciferae, Cyperaceae, and Caryophylleae, each numbering over 100 species. Both in the alpine flora in general and in that of the higher zone, the number of Compositae is nearly double that of any other order, numbering about one-eighth of the whole. Of the Saxifragaceae there are 42 species, of the Primulaceae 36, of the Gentianaceae 26.

The origin of the flora of the Alps is an interesting and somewhat complicated problem. I have already pointed out the great difference between the climatic conditions of Switzerland and those of the Arctic zone. In accordance with what might be expected from this fact, a close examination of the Swiss flora led the two highest authorities on the subject, the late M. Alphonse de Candolle and the late Mr. John Ball, to the conclusion that its nearest connection is not with the arctic flora, but with that of the mountains of Central Asia, especially with the Altai range. The arguments in favour of this view are very clearly brought out by Sir W. T. Thiselton Dyer, in his introductory note to a posthumous paper by Mr. Ball on the distribution of plants on the south side of the Alps, read before the Linnean Society on the 2nd of May 1895, and published in its *Transactions* (2nd ser. vol. v.). According to Mr. Ball, while only 17 per cent of the species found in the Alps are common to the arctic flora, 25 per cent are found also on the Altai range. Still more convincing is the interesting fact that some of the most remarkable and peculiarly alpine members of the Swiss flora (genera or species) are found only on the south side of the Alps, and are distributed at wide intervals throughout a discontinuous mountain chain extending from the Pyrenees to Central Asia; while they are entirely absent from Central and Northern Switzerland, and from the North of Europe. This is the case with species of *Oxytropis, Primula,* and *Pedicularis,* and especially with *Campanula cenisia* and its allies, and with the genus *Wulfenia.*

I have touched on only the more conspicuous features of the flora of the Alps. Those who have not yet turned their attention in this direction will find how much is added to their enjoyment of an alpine tour by even a slight acquaintance with its salient features.

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The Scope of Natural Selection.

By J. Lionel Tayler.

A reconsideration of a few of the chief objections which have from time to time been urged against the theory of natural selection may, in view of the more recent development of its principles, be not without some value at a time when test cases to decide the question of use-inheritance and the power of natural selection are being continually brought forward.

In this paper I shall throughout follow Lloyd Morgan, Mark Baldwin, and others in the precise usage of the terms, variation, modification, adaptation, and accommodation.

Variation will apply to changes which are of germinal origin.

Modification will apply to changes which are impressed on the "body" or soma in the course of individual life.

Adaptation will apply to those changes which have been produced by the selection of favourable variations.

Accommodation will apply to those alterations which have been produced by the reaction of the soma to environmental conditions.

We may seek to interpret the facts of organic evolution by resting wholly or in part upon one, or a combination of more than one, of the following assumptions:—

1. That organisms have evolved along definite lines, wholly or chiefly dependent upon the nature of each organism, developing either completely or partially irrespective of the peculiarities of the environment. On this view the more or less unsuitable organisms are simply eliminated, but this elimination is of little or no importance in development, the assumption being that every organism that is not exterminated evolves at its own rate, and that its development is neither retarded nor accelerated by the presence or absence of other organisms.

2. That organisms are modifiable by environment and that modifications so produced are inherited, the hereditary relation being subservient to the action of the environment. This assumption has to be considered under two heads.

(*a*) Accommodations which are the direct result of environmental influence.

(*b*) Accommodations which result from the activity of the organism itself in response to its environment.

It is obvious that these two classes, though not usually so considered, are in reality fundamentally distinct. Class (*a*) includes the only kind of inherited characters that can be truly called acquired. Class (*b*) includes what are in reality merely developments of already existing somatic tendencies, which some biologists believe may, and others that they may not, become germinal. In any case there must be an elementary something which can be developed by use or there would obviously be no development, but rather the formation of a *new* character, and the accommodation would then have to be classed under (*a*). In class (*a*) the influence of the environment in producing a modification is one of primary cause and effect; in class (*b*), on the other hand, the influence of environment is secondary, it is the indirect cause of the degree of the response, but not of the capacity of responding which exists in the particular form of protoplasm itself. Class (*a*) is incompatible with selection, for in proportion as direct modification is able to occur, the less is the necessity of selection, and this direct climatic influence must obviously be also inversely proportional to the power of heredity. Class (*b*), on the other hand, is not necessarily in opposition to the selection theory because within certain limits the more responsive the organism the greater the rapidity of development, selection would become simply more rigorous, the selection value would be raised, the less responsive organisms being weeded out.

There are thus two separate questions in this division to be answered:—

1. Does a direct somatic alteration of structure ever occur as the result of climatic or other physical influence, and if so, how frequently and under what conditions? Do these alterations become germinal? or
2. Do all, or any, somatic modifications to environment arise as developments of a pre-existing element in protoplasmic structure? If so, do somatic responses ever become germinal? For a clear statement of the Lamarckian position it is necessary to determine the relation, if any exists, that class (*a*) has to class (*b*).

3. By the selection of organisms which possess favourable variations, and by rejection of those which have unfavourable, the offspring resulting will tend to reproduce the favourable variations of their parents, and the selection being continued in every subsequent generation, so long as conditions remain fairly constant, there must

inevitably result an organism which tends to vary more and more definitely.

To determine how far evolution has been dependent on one or more of these three factors, it is necessary to estimate—

I. The direct accommodative power of environment over protoplasm, if it exists.

II. The power existing in protoplasm of responding to conditions which favour its activity, and the relation, if any, that somatic response bears to germinal in multicellular organism.

III. Whether the responsive power (II.) or the direct influence of environment (I.) are altered in relation to present by past accommodations, or variations, or both, and if so, the relative importance of the character, intensity, and persistency of these past conditions in producing more or less permanent or transitory modifications or variations in organisms.

It follows from the preceding argument that it is necessary to understand the theoretical capability of each of these three sets of factors to account for the process of evolution, and to endeavour to form some estimate of the probable primitive material from which the present forms of life have proceeded.

In this article I propose to examine this question from three aspects, first, the theoretical capability of natural selection, secondly, some of the chief difficulties advanced against this principle, and lastly, a few of the more general properties of protoplasm and the inferences which these main characteristics appear to justify.

The Limitations of the Principle of Natural Selection.

Ever since the publication of the "Origin of the Species" in 1859, there have been steadily rising into greater prominence, two lines of thought which seem to lead to fundamentally opposite conceptions of the principles which underlie the process of organic evolution. One tendency manifests itself in an increasingly marked disposition to minimise the claims of—use and climatic—inheritance, and to explain the course of evolution by the single principle of selection and certain fundamental properties of protoplasm. The other school of thought tends as emphatically to disregard this selection principle, and to rely on the responsive power of protoplasm and the influence of environment as the main causes of evolutionary development. Some of the members of this school also add to these assumed properties of protoplasm, other innate tendencies by which protoplasm is supposed to be capable of developing along definite lines which are independent of environment. In the one case, the supporters of selection maintained that, as no case of supposed use-inheritance had ever been brought forward which could not be as easily, or even more easily, accounted

for by the single principle of survival of the fittest and elimination of the less fit, they were justified in considering natural selection to be the main or sole principle in species formation. In the other Neo-Lamarckians based their objections to natural selection on the assumption that modifications in nature were always or nearly always definite, that definite modifications were admittedly unexplainable on the selectionist theory, it therefore followed, as nature could produce definite modifiability, without the aid of natural selection, that, unless some special and additional reason could be found for its existence, the selectionist principle must be regarded as wholly subsidiary in nature, and that it could only be regarded as a species-former in the limited field of the domesticated organisms which were under the direct influence of man. Neither position could be regarded as satisfactory, since each school of thought was apparently supported by some facts, while negatived by others. Professor Lloyd Morgan, in an article contributed to *Natural Science* in 1892, altered the whole force of the arguments advanced on both sides by demonstrating the fact that if natural selection acts at all, it must tend, under moderately constant conditions, to produce definite variability through survival of the favourable line of inheritance, and extermination of the unfavourable. This corollary to the principle of selection he has further expounded in his work on "Habit and Instinct" in a chapter entitled "Modification and Variation."

In an article published in this journal for April 1898 I contended that natural selection was capable of producing in the whole organism a general definite variability under relatively constant conditions. I was at that time unaware that Professors Lloyd Morgan and Weismann[1] had both in large part anticipated me.

The former writer's views may be summarised briefly as follows:—

The theory of natural selection, involving as its fundamental principle the assumption that an organism survives solely because it has certain favourable elements in its nature which give it certain advantages in the competition for existence, the less favoured organisms being eliminated, it follows, in so far as parental characteristics are able to influence those of their offspring, that the progeny of successful parents will be likely to inherit a higher average of adaptability to their environment, and as this average adaptability will keep rising so long as selection lasts, it will tend, under more or less constant conditions, to produce more or less definite variability. Definite variability is not therefore necessarily inconsistent with the principle of selection. If it exists only where the conditions are such that the principles of the theory would lead any impartial biologist to expect such definite variability it will be strong confirmation of the truth of the theory in question.

Every living organism may be considered from two aspects—(1) it

[1] In his theory of "Germinal Selection" put forward in September 1895 at Leyden.

tends to develop and maintain its own structure, (2) it tends to reproduce, under suitable conditions, other organisms more or less similar to itself. We have therefore to consider every living form from a somatic and a germinal side. Both somatic and germinal aspects exhibit two tendencies which are differently proportioned in different organisms, (1) to remain constant in spite of variable external conditions, (2) to manifest certain changes of structure. According as one or other of these tendencies predominate the organism will develop and reproduce definitely or indefinitely. In both somatic and germinal development natural selection will tend to favour the requisite definiteness or indefiniteness of structure. The inheritance of somatic characters does not appear to have been established in any one of the many alleged examples; the evidence, therefore, that up to the present time has been collected, would seem to favour the conclusion that if accommodations are ever inherited it is an event of extreme rarity.

Yet in spite of the lack of evidence in support of the inheritance of acquired characters, there seems to be a considerable mass of evidence in favour of the contention that germinal variations often correspond in their tendencies to somatic accommodations.

Definite variability corresponding to environmental accommodation might however be acquired in the following way. It has already been noticed that every organism, both from its somatic and germinal aspects, exhibits two tendencies, one towards definiteness, the other towards indefiniteness; somatic indefiniteness appears to be able to be modified by environmental influences, therefore those organisms whose somatic tendency is predominantly plastic will survive under altered conditions of environment where those organisms of a less easily modifiable tendency will be eliminated. Now if somatic characters rarely or never become germinal, the modifications of the parental organisms cannot be transmitted to their offspring, but those offspring that happened to be endowed with variations in the same direction as the acquired but not transmitted modifications, would start their life with a predisposition favourable to their environment, and therefore favourable to more complete modification of the somatic side of the organism; this tendency being accumulative under constant conditions, coincident variability would arise by the process of selective elimination and preservation, *without* the need for the assumption of use-inheritance, which assumption facts appear to negative.

Coincident variations would thus have a better chance of survival simply because they would be present in the surviving organisms, but the principle of selection would be the same whether the variations were coincident or not.

It follows from the preceding argument that definite variability is a logical necessity, under certain conditions, if the principle of natural selection be allowed to be a factor of considerable importance

in organic evolution. So far all facts point to the conclusion that variations under stable conditions are definite, under unstable conditions indefinite, and this definiteness and indefiniteness occur under precisely those conditions which the theory of natural selection would lead one to expect; hence, unless definite variability can be shown to occur under conditions which selection could not have produced, the facts adduced by the Lamarckian School are favourable rather than otherwise to the Neo-Darwinian position.

To realise how far the theory of selection is capable of explaining the facts of organic evolution, it is necessary to bear in mind the postulates on which the theory is founded.

1. It is obvious that Natural Selection can only act by preserving or eliminating the complete organism. Selection must therefore be organismal. This Darwin and other selectionists have clearly recognised.

2. As the whole organism must survive, if the favourable variation or variations are to be preserved, it follows that certain minor unfavourable variations may also be preserved if they happen to exist in an individual which survives on account of its major favourable variations. And since no individual is completely adapted to its environment, it follows that there must be always a variable amount of residual unfavourable variability in every organism.

3. This residual unfavourable variability may be of considerable utility under changed conditions.

4. Complementary specialisation of parts, as Spencer has shown, is favourable to successful competition, and as it is the whole organism that is selected or eliminated, it follows that any weakness of one specialised part, since it would disturb the balance of all, would be detrimental. The more complex the organism, the more specialised the structures, the more dependent one part will be on the others for its existence, hence a complementary specialising tendency will be favoured by selection, and therefore all struggles of one part of an organism with another will be reduced to a minimum.

It is clear that there must be some underlying criterion which determines whether any given organism shall be selected or not, and that criterion must be the net result of its adaptability to its environment. One organism may conceivably survive, by its possession of a large number of small favourable variations, while another may survive in virtue of a single valuable one, but in each case it would be the *whole value* of that organism which determined its survival. This fact is continually disregarded by opponents of the Neo-Darwinian position, yet this selection of the organism as a whole is the fundamental postulate from which the theory of selection starts. Thus it is not uncommon to read criticisms bearing on the early development of some organ, in which the inadequacy of selection is supposed to be proved by the writer demonstrating, or believing he has demonstrated,

the fact that the particular variation in question must have been too small to be by itself of selection value. In many cases the particular variation would, no doubt, if taken alone be, as the objector asserts, too unimportant to be selected, but as it is the whole organism that is selected, it is not logical to make an artificial separation and study the development of one organ or structure irrespective of the other organs with which it is in nature associated. *Every organ in its evolution must be considered in relation to the whole of the particular organism in which that particular stage of development of that organ is found.* Starting therefore with this fact that the net value of adaptability of the whole organism to its environment must be the basis which determines selection or elimination, it will follow that certain lines of development will result from the application of this criterion. In a series of organisms placed under new conditions, elimination will proceed along lines essential to bring about a proper adjustment to the new conditions. If the offspring of these adjusted organisms merely repeated in their generation the characters of the exterminated as well as of the surviving organisms, that temporary adjustment would be permanent as long as the conditions were unchanged. But since the offspring are produced only by the surviving organisms, selection is continually raised to higher and higher planes of adaptation, and therefore, as long as conditions remain constant, the tendency of selection must be, as Darwin clearly saw, cumulative. He did not, however, apparently see that from this cumulative tendency definite variability must arise out of indefinite.

Selection in direct relation to climatic conditions is therefore of very minor importance, while selection among the members of a species and all forms of inter-organismal selection is of infinitely more importance, since it is this interaction, produced by the offspring in different degrees inheriting the advantages of both parents (both of whom have survived on account of certain advantages), that leads to the cumulative development and never-ending struggle for survival. Darwin came very near to this conception of definite variability when he pointed out that "if a country were changing the altered conditions would tend to cause variation, not but what I believe most beings vary at all times enough for selection to act on." Extermination would expose the remainder to "the mutual action of a different set of inhabitants, which I believe to be more important to the life of each being than mere climate,"[1] and as "the same spot will support more life if occupied by very diverse forms,"[1] it is evident that selection will favour very great diversity of structure.

Bearing in mind this cumulative action of selection it will follow that under constant or relatively constant conditions the struggle for successful living will become more and more selective in character,

[1] From Poulton's "Charles Darwin and the Theory of Natural Selection" (Abstract of Darwin's letter to Professor Asa Gray).

even if the actual number of inhabitants remain more or less the same as when the struggle first commenced. The selection of variations will thus tend to pass through certain more or less ill-defined but nevertheless real stages. In proportion as the struggle becomes intense, either from the number or from the increasing adaptability of the organisms, or both, certain major essential adaptations, which were necessary for the climatic and other more or less comparatively simple conditions, will be supplemented by minor auxiliary variations which in the earlier stages would not have appeared. And still later as more and more rigorous conditions of life were imposed the advantage would tend to rest with those organisms which possessed highly co-ordinated adaptations, since this would entail more rapid responsiveness to environment.

As evolution advances from the unspecialised to the specialised, and higher and higher forms of life come into being, with increasing complexity and specialisation of parts entailing an increasingly delicate adjustment of those parts to each other's needs, the relation of each part to the whole organism becomes of more and more importance, and it follows that selection must become more and more generalised in its action. No single variation could be of service to any of the higher forms of life unless it was in more or less complete harmony with the whole tendency of the individual. The adjustment of parts and their mutual interdependence make it essential for adaptation that the relation of parts be preserved; consequently, correlated minute favourable variations will tend to be more and more selected as evolution passes from the unspecialised to the specialised forms of life. This response of the whole organism should be still more delicate in those forms of life that are continually subjecting themselves to changed conditions; hence this delicacy of adjustment is far more necessary in the higher forms of animal life than in the more stationary plant organisms, and in the developing nervous system of animals we have just the central adjusting system that is required for these conditions. *With evolution of type there will thus be an increasingly definite tendency given to organic, especially the animal, forms of life, if the acting principle of evolution has been selectional.* Selection is therefore able to account for the steadily progressive tendency of life as a whole without calling to its aid any unknown and doubtful perfecting principle.

To summarise:—Natural selection, acting on the whole organism, tends to produce more and more definite tendencies in all surviving forms of life, which tendencies are progressive and continuous in character. Variable conditions, by partially altering the line of selection, induce a temporary indefiniteness. And lastly, the process of selection being itself able to be the indirect, though not the direct, cause of those favourable variations, which it subsequently selects from, is able to dispense with any subsidiary factors, provided it has a

certain number of elementary properties of life which afford sufficient material to work with.

Objections to the Theory of Natural Selection.

Keeping constantly in view the leading principles of the selection theory I believe it will be found that the facts adduced by the more scientific opponents of this theory can, when the importance of the corollary put forward by Lloyd Morgan, and after him by Weismann, is considered, be easily accounted for, and that as they then fall into line with its legitimate deductions increase the strength of the theory by showing it to be a more and not less important principle than Darwin and even Wallace were led to believe.

1. *Variations are definite and not indefinite in nature.*—This objection has already been met in the preceding part of this article, and as selection is able to explain the indefinite variability which arises from variable conditions, crossing, etc., and the constancy of type from rational inbreeding, it is in more complete accord with facts than any mainly Lamarckian or Orthogenetic theory.

2. *That Natural Selection cannot be the cause of New Characters —The alternative must be present before the selection can commence.* If any character or variation can be shown to have been produced which differs qualitatively, not merely quantitatively, from its parental forms, which is not to be explained by incomplete development, atavism, or degeneration; if any variation can be shown to arise, which has not some pre-existing though less or more differentiated counterpart, it would form an objection of considerable magnitude. But as no case of the kind has been put forward which Neo-Darwinians have felt bound from the strength of the case to accept, this objection may be disregarded until such case arises.

3. *The difficulty of the chance variation appearing at the right moment* is largely met by the fact that selection tends to induce determinate variability; this objection is still further weakened by the fact that even relatively rapid changes in nature are, as a rule, long in proportion to the life of the individual, and afford considerable opportunities for selection working through somatic accommodations and later coincident germinal variability to produce the required change.

4. *That the earliest forms of variations must have been too small and insignificant in character to be of selectional value.*—This objection appears to me to be one of the most weighty of all the objections which have been raised to the selectional hypothesis, and it is further an extremely difficult objection to satisfactorily reply to; first, because it is almost impossible to say in what form of organism the earliest variations appeared, and without this no judgment on the value of any small variation can be of use; secondly, it is equally essential to know the kind of environment which such an organism

was living in; and lastly, if we were fully acquainted with the character of the organism and its environment it would still be difficult to form any adequate opinion on the value of such a variation, owing to the fact that this apparently simple organism would differ so widely from our own functional activity and life that any conclusions formed on comparative methods of testing its powers, etc., would be extremely likely to be fallacious. If, however, we keep in mind the facts that (1) the whole and not merely a part of the organism is selected, and that, therefore, each variation does not require to be of the same value as if selection depended on it alone; (2) specialisations are largely quantitative, between man at one extreme of development and a simple unicellular organism at the other, the difference though very great, is mainly due to the fact that man is a huge multicellular colony; this difficulty will be much simplified. To estimate the qualitative difference it is necessary to endeavour to determine the specialisation of an individual cell in one of those collective specialisations or organs: the difference between a cell in, for instance, the cerebral cortex of man and the character of an amoeba is no doubt great, but the amoeba reacts to stimuli, though in a less specialised form just as the cortex cell does; in the same way the reaction to light in the mammalian eye is not a new development—it has its beginnings in the preference for light or darkness shown by many unicellular organisms. These two points that selection is organismal and that specialisations are as, or more, largely quantitative than qualitative, weaken if they do not abolish all those difficulties to natural selection that are founded on this objection, and it is further necessary to recollect that no specialisation has yet been found which has not a primitive counterpart in the earliest known forms of life.

5. *The Imperfections of the Geological Record.*—This is obviously a much less important objection than the preceding one. The very large areas of the world that have yet to be examined tend very much to weaken any objection founded on imperfections and absence of links. And as with increasing research these missing links are being steadily filled in, it follows that this objection has become weaker and not stronger with advancing knowledge.

There are, however, certain points which it is essential to recollect in any consideration of the imperfections arising from this cause. Lloyd Morgan has pointed out that, as the tendency of natural selection is to favour, under appropriate conditions, definiteness both in the soma and in the germinal structures, the geological record should not be expected to provide evidence that does not correspond to this definite line of development.

There is also another point which does not appear to me to have been sufficiently emphasised. In the earlier part of this paper I drew attention to the fact that Darwin considered the mutual action of a different set of inhabitants arising from the birth of a new generation

to be of more importance than the mere conditions of climate, etc., and inasmuch as climatic selection will largely cease acting as soon as organisms, capable of surviving at all under these altered conditions, are produced, it follows that inter-organismal action, which is continuous, must be of more importance in species formation and differentiation of structure. But as organisms which cannot survive under these altered conditions will be eliminated, it follows that the more obvious structural changes will be largely produced by this temporary climatic selection, and this form of selection will be remarkably rapid in its action relatively to the inter-organismal selection. Hence the obvious structural changes induced by climatic selection will have less chance of leaving a geological record behind them than the less obvious variations induced by inter-organismal selection. For this reason certain imperfections in the record are likely, and should be expected, to arise.

6. *That the period of time is too short for such great alterations of structure to have taken place.*—As the rapidity or slowness of structural alterations will depend on the local surrounding conditions, it follows that, until some fairly complete record of these local conditions is obtainable, no objection as to time limit can be logically raised.

7. *The co-ordination of parts necessary for the development of favourable adaptations.*—Spencer has pointed out that co-ordination of many parts to form one adaptation is based on a different principle to the cumulative results of many different variations each of which is of selective value, and urged that natural selection is powerless to explain this co-existent adaptation.

Wallace, in referring to this subject, says:—"The fact, that in all domestic animals, variations do occur, rendering them swifter or stronger, larger or smaller, stouter or slenderer, and that such variations can be selected and accumulated for man's purpose, is sufficient to render it certain that similar or even greater changes may be effected by natural selection, which as Darwin well remarks 'acts on every internal organ, on every shade of constitutional difference, on the whole machinery of life.' The difficulty as to co-adaptation of parts by variation and natural selection appears to me, therefore, to be a wholly imaginary difficulty which has no place whatever in the operations of nature."[1] This criticism does not appear to me to do justice to Spencer's objection; he would no doubt agree with Wallace that these accessory variations can be developed by selection, but he would go one step farther back and ask why it is that the accessory variations happen to be there to be selected from at all. He would agree to the fact that selection must act on the whole machinery of life, but he would still urge that he is unable to see how it is that all these numerous accessory variations which are necessary to the working

[1] "Darwinism," p. 418.

of one variation happen to be present at one and the same time. His difficulty therefore does not appear to me to be answered by Wallace.

Weismann,[1] admitting the objection of Spencer's as having a real existence, attempts to answer it by the tendency of natural selection itself to induce definite variability. This answer does not seem to me to be much more satisfactory than Wallace's, for the point of the argument is, that as the accessory variations are necessary to the proper working of the primary they must be present from the first selection, and as determinate selection can only appear after selection has been continued for some generations it must be unable to explain this occurrence of co-ordinated parts which occurs prior to the action of selection.

Mr. Lloyd Morgan in the December number of *Natural Science* deals with this difficulty in a manner which appears to me to be much more satisfactory. We have seen in the brief summary of his views that he draws an important distinction between somatic response to environment and the selection of germinal variations, that under altered conditions of environment he considers somatic plasticity to be one of the principal determining causes of selective preservation, and as he admits the action of use-modification on the somatic structures, those organisms whose somatic structures are sufficiently plastic to allow of this newer co-adjustment to the newer conditions will survive on account of their plasticity, and this will continue to happen over one or more generations until chance variations happen to make their appearance in the same direction as the environment, then the offspring of this organism or these organisms will start life with a slight favourable predisposition to their environment, which in addition to somatic plasticity will give them a slightly better chance than those without this predisposition, hence by the fostering power of body response a co-ordinate structure might be formed through cumulative co-incident variability. This objection therefore does not apply to the theory of Natural Selection modified as above.

Keeping in view this theory of co-incident variability, there is another consideration which will also tend to weaken this objection. As selection must be from the first organismal, and as adaptation to climatic conditions must be absolute, as far as it is capable of exercising a selective action, a certain common tendency will be present in all more or less similar organisms living under these more or less similar physical conditions. This primitive climatic basis will give a certain direction to the subsequent inter-organismal selection, and we have seen that with progressive evolution the necessary specialisation entails an increasingly definite tendency in the organism as a whole, owing to the increasing dependence of one part on another: hence it will follow that all variations will tend to become increasingly co-ordinated as they become increasingly specialised, and they will also become increasingly so as we pass from the lower to the higher forms.

[1] "Germinal Selection."

There will thus be very little tendency for incoördinated variations to appear, and this tendency will diminish with evolution of type.

8. *That organisms not uncommonly exhibit a more perfect organisation than their environment demands.*—This statement is frequently associated with other similar objections, some of which, such as definite variability, and varying degrees of capacity to vary in different animals, have already been met; it is also asserted that animals sometimes manifest at the earlier periods of their lives a higher condition than at a later period, and that this higher earlier condition cannot be explained by any assumption of reversion in the later stages of growth, thus it is asserted that the infant ape is much nearer to man than the adult ape, etc.

All these assumptions have as a basis the conscious or half conscious belief in some unknown internal force which is capable of producing evolution of type independently of environment. To Lamarckian and selectionist theories alike any such force, were it proved to exist, would be largely fatal.

It has been shown that an increasingly definite tendency in organisms evolved through the principle of natural selection is what on theoretical grounds one would be led to expect—that the preservation of a definite relation of one part to another becomes of increasing importance with increasing specialisation. That this is actually the case, the facts associated with "internal secretion" in man and the higher mammals clearly prove. The thyroid, kidney, liver, pancreas, testes, and ovaries, etc., have been shown to exert some remarkably important influence on the nutrition of the whole body, and this influence in the case of the thyroid, and less certainly in other organs, has been found to be produced through the throwing off of certain products into the circulation which are necessary to the metabolism of the whole body.

On any theory of complementary specialisation of parts such facts are easily understandable. A chemical circle of nutrition would be the most economical way of maintaining tissue activity; if each organism can act chiefly on some particular substance, one organ or tissue requiring a more complex food material than another to carry on its metabolism, then the waste product of one organ might be used as a food product by the next in this food series, until the last organ of this series, having obtained all the energy from this material, excretes this simpler substance, which cannot be further utilised by the body, into some channel where it is got rid of. Some such hypothesis is necessary to explain the facts, and the increasing series of progressively simpler products, although still incomplete, that have been obtained, which are allied to uric acid and other substances, lends considerable support to this theory. There would be thus a serial specialisation of food supply among the tissues of each organism which would be as economical as the specialisation of food supply among

individual organisms competing in nature. Now this close relation of one part to another which is characteristic of the adult organism is also equally characteristic of the developing one, and, keeping this sequence of nutrition in view, each organism starting from a more or less quantitatively generalised substance, evolves to quantitatively specialised structure, in the building up of which every antecedent stage of development is necessary, and forms a basis for the later stages, it will follow that a definite, regular order will be developed; *and hence definiteness in growth and development is as essential as definiteness in the relation of one part of a specialised organism to another.* That this necessary sequence in development is no mere unsupported conjecture is shown by the fact that the relation of parts alters with growth, an organ occupying a first place in activity at one period may become second or third at another, this alteration of the relative size of different organs to the whole body at different ages must be of some value to the whole organism or it is unlikely that it would be perpetuated; the thymus gland affords a typical example of this—it appears in some way to be associated with development, it reaches its maximum size in man about two years after birth, and then slowly shrivels up; the presumption is that at that period it had some function to perform which ceases to be required. If we assume a metabolic sequence in structure we explain this varying relation of parts, and we explain its definite character, and this sequence, as in other specialisations, would be subject to the influence of natural selection; so far preservation of different stages of growth can be easily accounted for on a selection hypothesis if this necessary chemical sequence is assumed, and without it no theory has as yet explained the facts.

There thus remains from this objection only those cases where there is an apparent or real foreshadowing of a higher evolutionary type. Now before this foreshadowing can be used as an objection, it has first to be determined how far it is real or not. It is well known that the ovum of one animal resembles another considerably, and that the higher animals, as they pass through successive stages of their development, resemble more or less incompletely certain lower forms of adult organisms, and this has led to the assumption of the recapitulation theory. Were it possible to reverse the order of evolution and proceed backward, we should find all types converging towards unity, and while this applies to the whole line of development, it equally applies to lesser portions of it. As the infant ape is less specialised than the adult ape it is more likely to present similarities to man, not on account of an actual foreshadowing, but simply because, being more generalised in structure, it is less easy to mark off differences; for precisely the same reason a human child might appear nearer to some ideal and higher type of man.

Until this fictitious resemblance is dealt with this objection can be disregarded. Further, as many biologists have already pointed out,

there is always a certain excess force, which would be fostered by selection, sufficient to provide for emergencies.

9. *Rudiments and their disappearance.—It is assumed that there will come a point where the rudiment will be of such slight significance that it will no longer be of selection value, hence it is urged that the fact that rudiments do tend to completely disappear, is against any purely selectionist principle.* Leaving out of consideration the possibilities of reversal of selection, panmixia, etc., it appears to me that there is a comparatively simple cause for this disappearance. George Henry Lewes, Wilhelm Roux, and more recently Weismann, have all fallen back on the assumed necessity of applying the principle of selection to the several parts and specialisations of the individual organism, in addition to the action of selection on the whole organism. The last writer in particular, in his "Germinal Selection," suggests that a struggle among the different parts of the germ-plasm may account for the complete disappearance of rudiments, this germinal selection thus supplementing the action of panmixia, personal or organismal selection, etc. Now the necessity for increased co-ordination of parts with increasing specialisation, entailing, as it necessarily must, an increasing mutual dependence of each part on the others, must lead as the type advances to diminished opportunity for any struggle of parts in the organism, consequently if such a struggle exist at all it must be limited to the most undifferentiated organisms. I do not therefore see how this principle can explain the disappearance of rudiments in any of the more specialised organisms, hence it does not seem to be sufficient answer to the above-mentioned difficulty. In the development of the individual we see a disappearance of structures, which appear to become with advancing development useless, almost parallel to the gradual disappearance of rudiments, etc., in the history of the species evolution. And a common explanation for both of these series of phenomena can, I believe, be satisfactorily found in the known facts of nutrition. Growth of any tissue would seem to depend on three conditions, a stimulus of the part adequate to promote functional activity, a proper food supply, and efficient removal of products produced by that particular tissue's activity. There is abundant evidence to prove that a tissue tends to degenerate if its own excretory products are not removed; the evil effects produced by fatigue products in muscle and other tissues on the activity of the tissue itself prove that this factor must be of great importance wherever it is found to occur. Just as the growth and development of bacteria is interfered with, and finally altogether checked by the accumulation of products of their own activity, so a tissue in the higher organisms has its activity impaired and its power lessened when for some reason diminished elimination of its own metabolic products occurs. Now both in the development of the individual and the race we see an alteration of structure, a gradual transition from the less to the more specialised,

and in this gradual transition there must be, as I endeavoured to prove in my answer to the last objection, an alteration in the line of functional activity of the parts, and that, owing to this fact, a tissue that was necessary in the earlier stages, became less and less so as specialisation advanced, the whole tendency of the specialising organism being continually and increasingly against the earlier, less specialised, stages. It will thus happen that every structure which is becoming useless owing to its deficient specialisation, whether in the history of the race or the individual, will have two adverse sets of conditions to contend with—one defective elimination of its own tissue products, owing to its becoming increasingly removed from the growing organismal specialisation of food products, while secondly, for this same reason, its own food supply will become less and less suitable. This theory would apply equally to germinal and somatic development and atrophy of structure; there would thus, through the alteration of functional activity of the whole organism, be brought about elimination of all structures not in the line of evolution, and therefore organismal selection alone, if this theory is sound, would be able to explain the complete disappearance of rudiments, the various forms of development and atrophy, without calling to its aid climatic inheritance, panmixia, and germinal or any other form of particular selection.

The only two other important objections against the principle of selection are (1) those cases where it is assumed that automatism produced by habit has become hereditary (instinctive),[1] an assumption which an examination of the facts does not appear to warrant, and (2), those cases which are supposed to be examples of experimental demonstration of acquired inheritance.

In the best known of these experiments, particularly those performed by Brown-Séquard, we have certain facts which appear to show that under very exceptional conditions somatic injuries may affect germinal structures. Assuming that reliance may be placed on this interpretation of these experiments, an interpretation which future facts might conceivably negative, there are other facts associated with the relation of environment, alcohol, etc., to crime and insanity which would seem to offer some slight confirmation of this view. If further investigation proved the possibility of somatic responses affecting occasionally the germinal structures, it would only affect any theory of heredity which was based on the assumption that somatic and germinal elements were completely isolated. The purely selectionist position would remain intact unless direct climatic accommodation could be also proved to be a factor of importance. The objections to the selectionist theory do not appear, therefore, when examined, to be valid.

[1] See Lloyd Morgan's "Comparative Psychology" and "Habit and Instinct," and Mr. E. L. Thorndike's experiments.

(*To be continued.*)

Stray Impressions of the Marine Invertebrates of Singapore and Neighbouring Islets.

By F. P. Bedford, M.A.

Nearly all the facts mentioned in the following account are probably well known, but so few English naturalists seem to have visited the Malay Peninsula with the object of studying its marine invertebrate fauna, and my own preconceptions of marine tropical life derived from lectures, books, and specimens, which more or less faintly recalled their original form and colour, were so vague and so often erroneous, that I cannot help thinking that there may be many who, from lack of the opportunity or possibly the desire to travel in the tropics, may be in a similar predicament. If this is so, a few of the impressions produced on one's mind may not be entirely devoid of interest.

No doubt all who are interested in the subject will have read such books as Professor Hickson's "Naturalist in North Celebes" and Professor Semper's "Animal Life," books written in a most suggestive and lucid style, made the more convincing by the intimate practical knowledge which the authors possessed of the animals they describe. I cannot of course pretend to any such knowledge on my own part, and I would not venture to traverse ground which has already been so admirably reconnoitred, but there is a purely superficial aspect of the subject which some months' collecting in the neighbourhood of Singapore has impressed on my mind, and which may be worth attempting to describe before it has become obscured by the details which assume an increasingly prominent position in one's thoughts the longer one collects.

One of the first impressions produced when one either turns over stones or digs at low-tide, or dredges or trawls in the sea beyond, or examines the results of surface tow-nettings after dark, is the marked similarity of the fauna to that of our English coasts. At or near the surface at night are Appendiculariae, Copepoda, Malacostracan larvae, Chaetognatha, Medusae, Siphonophora, and Ctenophora, many of which, to the naked eye at least, are quite indistinguishable from those which might be obtained in a similar way at Plymouth or Port Erin, such forms as Heteropoda, Pteropoda, and the larger pelagic Tunicates being by no

means common as a rule. In the dredge are obtained, according to the depth of water, nature of the substratum, strength of currents, etc., different forms of invertebrates which, as a rule, recall at once some English genus, the most noticeable being perhaps the Sponges, Hydroids, Gorgonians, Polyzoa, Ascidians, and the five groups of Echinoderms. The littoral fauna is not at first sight strikingly unusual except in those places where the reef-building corals flourish; here undoubtedly a surprise awaits any zoologist who sees them for the first time. Often as he may have seen the beautiful photographs in Saville-Kent's well-known work on the Australian Barrier-reef or collections of coral such as are exhibited at the Natural History Museum at South Kensington, or often as he may have read the accounts of Darwin, Dana, Murray, Semper, and others on the formation of coral reefs, he will hardly, until he is brought face to face with the reality, have been able to form a mental picture which at all adequately represents the actual charm and beauty of the living coral, reposing calmly "like a flower garden" (as I think Moseley described it) beneath the seemingly unnatural transparency of a tropical sea.

In these shallower waters, which rarely exceed a depth of 30 fathoms, the reefs differ considerably from those usually described, and a short account of them may not be out of place.

The reef-building corals form a fringe which is by no means always continuous round the islets or on the margin of the coast; on the latter especially there are extensive tracts covered with sand or mud, and with occasional mangrove swamp, but totally devoid of reefs, coral being represented by small clumps distributed very sparsely at intervals of often several yards. In places where the reef is present, its distance from the shore varies from a few yards to half a mile or more, and in many cases no part of the reef proper is dry at low spring-tides; the actual width of the reef itself is also very variable, but rarely exceeds about ten yards; on its outward edge it slopes somewhat abruptly to about five or six fathoms, and then more gradually seawards. Between the reef and the shore there is nearly always a flat covered with mud, and very often with an abundant growth of brown sea-weed which harbours a large fauna. This mud flat is very nearly level, and at lowest spring-tides there is left about a foot of water in the deepest parts, the highest portions of the "flat" being just dry. The mud sometimes extends nearly up to high-water mark, but as a rule it is separated from the land by a belt of sandy or rocky ground, or occasionally by projecting volcanic rocks excavated by the sea into hollows, which on the retreat of the water form tide-pools, and contain numerous nooks and crannies in which molluscs, crabs, and other animals find a hiding-place. Here at any rate at first sight the naturalist will readily admit that he might be on English ground. As he looked more closely he would probably see large fleshy Alcyonarians abounding on the mud-flat, and to some extent replacing our anemones, the latter being only

locally common; he might also see large Holothurians basking in the sun, either stationary or crawling slowly over the mud, but the commonest groups would be those that he was already accustomed to. Hermit-crabs abound everywhere, and at night the shore will sometimes be almost covered with them; crabs and prawns shelter themselves in crevices or under stones or in the sand, and Spatangids, Chaetopods, and Gephyreans make their burrows in the sand or rocks; limpets, too, of a diminutive size it is true, but still obvious limpets, stick to the rocks with the same tenacious grip as elsewhere, and obviously fill the same place in the economy of nature; our common littoral Gasteropod genera, such as *Nassa*, *Purpura*, *Littorina*, *Trochus*, etc., are represented by forms closely similar both in form and habits, and many of the species seem to have extremely variable coloration as on our own coasts; in fact it would be difficult to name any characteristic difference. Polychaet tabes project from the surface on nearly every sand-flat, Lamellibranchs abound in the mud and bore into rocks and wooden landing-stages, Nudibranchs of brilliant colours, together with Polyclads, creep about on stones and sea-weed, and even the abundant *Periophthalmus* which forms so marked a feature of the littoral fauna as it bounds over the surface of the pools, or rests on some adjacent object just above the water, is after all only a goby, such as every boy-naturalist delights to hunt at home.

The conclusion thus seems forced on our attention that the broad features of marine life, the modes of adaptation of different groups to their inorganic environment, and the modes of life adopted in their mutual rivalries of offence and defence, are to a very considerable extent independent of geographical position or climatic influence, and what is perhaps more surprising, they would seem to be independent of the marked differences which undoubtedly exist among the higher vertebrates. The presence of numerous kinds of tropical sea-birds, of sea-snakes, of crocodiles, and of a host of curious fish seems to have made a scarcely appreciable impression on the habits of the lower forms; and from what we know of fossil fauna, commencing from the *Olenellus* and other faunas of the earliest fossiliferous rocks which have retained the imperfect relics of but a few of their once living inhabitants, it might be surmised that from that time onwards these same broad features have persisted all the world over, altered but slightly from time to time by the subsequent evolution from some of them of the Decapod Crustacea, Vertebrates, and other "higher" forms. No doubt, too, in a similar way the exclusively tropical forms, among which we may perhaps regard the reef-building corals as in this respect the most important, have led to modification of the animals dependent on them, but from a superficial point of view at least, the crabs, prawns, Cirripedes, Lamellibranchs, and Holothurians that live associated with them do not differ very considerably from their allies which are surrounded by other environments.

By most writers on tropical zoology much stress has been laid on these modifications, and we have all repeatedly been told of the brilliant coloration of tropical marine animals, of the way in which hermit-crabs wander far inland, of fresh-water crabs, etc., but to my mind the resemblances are much more striking than the differences, and all that I have attempted in the present article is to give some idea, necessarily very imperfect, of the general impression produced when collecting for the first time in these waters, and if it is thought that more detailed facts are required before any generalisations are possible, I can only hope that at some future time I may be able to contribute my mite to the common store.

Raffles Museum,
Singapore.

A Theory of Sleep.

By Professor A. L. Herrera.

Sleep is not peculiar to man, for it presents itself in every organism. "Protozoa themselves sleep," says Milne Edwards, and sleep must, therefore, have quite a general cause. Some substances (narcotics, anaesthetics) provoke sleep either by dehydration or by producing congestion in the nervous centres, etc. On the other hand, sleep does not invade every organ in the same manner; it presents itself sporadically in such organs as happen to be extremely tired, or in those that are not well fed. It does not, in short, essentially differ from hibernal sleep.

Let us seek then for a philosophical explanation comprising every particular case and requiring no suppositions nor vitalistic theories. I find but one entirely general cause: the delay of the protoplasmic currents in which life consists, as I stated in a special paper on this subject.[1]

The Sleep of Plants.

In animals sleep is characterised by the flaccidity of their locomotor organs, whilst leaves remain in their nocturnal state on account of a very remarkable rigidity that seizes them. Linnaeus once received from Prof. Sauvageau of Montpellier a shoot of *Lotus ornithopodioides* L., which began to flourish in a hot-house at the garden of Upsala. The great botanist examined the flowers directly they opened and observed that they disappeared on the same night. He believed at first that they had been thoughtlessly cut away, but had to acknowledge his mistake next day, as the disappearance of the flowers at night depends completely on the close approach of the adjoining leaves which form a kind of shelter for them. This observation afforded cause for fresh investigations, and it was discovered that every species of plants opens and shuts itself at an appointed hour, etc.

Explanation.—"The motor dilatation occurring in some leaves at the base of the petiole is due to two antagonistic factors, the one tending to raise the leaf, the other trying to bend it, but the former, being by nature the weakest, acquires an additional force whenever

[1] "Protoplasmic Currents and Vital Force," *Natural Science*, April 1899.

light and heat, endowed with a certain degree of intensity, produce an abundance of sap in the cells which increases the turgescence: it can then resist the action of the opposite factor." In short, this is but a mechanical effect of the delay of the nutritive currents coming up the leaves.

Dreams.

These vary both in essence and degree according to the state of the dreamer's circulation. Some hygienic exercise or the repetition of a lesson may probably cause certain neurons to go on moving during sleep. But when they have worked too actively in the course of the day they are liable to be utterly drained and exhausted when night comes, and when such is the case there may be dreaming of the facts that brought their fatigue about. An assiduous exercise of the neurons may facilitate their continuous development and action (*e.g.* in the student dreaming about his examinations again and again). Contrariwise, the absence of new impressions, or a limited exercise during the day, will allow the uniform rest of all the neurons and a thorough absence of nightmare (husbandmen).

Fixed ideas lead to madness, perhaps on account of an atrophy of the inactive parts, some limited congestions, hypertrophies, etc. This is no business of mine, but I must state that the possibility of the functions of some cerebral centres being accomplished independently is made manifest during sleep. This means that certain neurons become associated in an abnormal way, extending themselves too much, and that diseases of mind, disordered neuroplasmic vibrations, are not inhibited by the more powerful vibrations of sound judgment, this being then peacefully slumbering.

Causes of Sleep.

Theories on this subject are by no means wanting, but they concern man only; they are not capable of general application, and leave the innermost mechanism of the phenomena unexplained. I admit, if necessary, the action of poisons and that of the secretions of the organism accumulated during the day, but chloroform and hypnotism work in the same manner. Whether the brain be congested or whether it be anaemic, its functions are deeply modified on account of the delay of the currents. Moreover, the lowest animals (Protozoa) sleep and wake in accordance with the conditions of their activity.

I believe, therefore, that sleep originates, either in man or infusorian, in a delay or slowing of the protoplasmic or neuroplasmic currents, due to refrigeration, lack of nutritive fluids, congestion or anaemia. Everything grows wearied. Everything bores and is bored. Both Bütschli's foam and my protoplasmic mass made by synthesis, cease from visible movement after a certain period of activity. Briefly,

it is a mere question of provisions. When the oxidisable ferment is spent, when zymoses decrease, and almost all the material carried from the external to the internal medium is wasted, it is but natural that movements and currents become slower and slower. The organism is then said to be sleeping. And how many degrees there are from the simple yawn and somnolence to the drowsiness of a worn-out and fatigued traveller! But currents do not cease entirely—death is not the issue. The transport of materials is slowly continued from the digestive apparatus to the recesses of the organism, from the outside to the inside.

In wakening organisms oxidations increase little by little (just as in Bütschli's plasm when heated); the current is augmented (as in Herrera's plasm when it receives a slight addition of peptone); the reagents in the laboratory begin to bustle, the forge's reverberations swell, and the hymn of work grows louder and louder until it finally attains the pitch of thunder. Bear this in mind, that the act of waking is a slow one, having many degrees and shades. At the break of day our sleep is light, and we begin lazily to stir ourselves without even opening our eyes, whilst we remain fluctuating in a pleasant languor.

Keep this rule in mind; whenever there is a cause, be it *y*, *z*, or *n* that modifies nutrition, sleep will increase in the exhausted convalescent, in the newly-delivered mother, in the child endowed with an exceedingly active circulation, in the inhabitant of the tropics whose salts and water are perpetually drained by the everlasting cupping-glass of climate, in the traveller, in the drunkard, in Bütschli's "artificial protoplasm," and in my own when seen under the microscope at their respective periods of activity and asthenia, in the glutton who ingests and absorbs large quantities of nutritive material, and in the youth who has provoked great waves of commotion which propagate themselves through vast nervous territories. On the contrary, old people and sedentary persons sleep both badly and scantily, as they stand in waiting for death.

I do not admit, O metaphysicians! the existence of any hard and fast line between sleep, this anaesthetic of life, and waking. I do not believe, O vitalists! that an organism can ever be either completely awake or completely asleep. There is always something living, one organ sleeping and another palpitating. A goose never happens to shut both its eyes at once. My own heart has at no time slept as my brain does; it hardly ever rests, poor perpetual sentinel! And you, O muscles? We yawn, wake and work too. There are some disinherited, beggared organs sleeping in ascetics. Yet, there is a weak and slow nutritive current even there.

I deny, then, any hard and fast line; there are no barriers between sleeping and waking, just as there are no absolutely separated and divided things in nature, whether stars or organisms.

But the day comes when both the currents and the general

irrigation cease; my Amazon is dry and the pale brain can drink no more from the drained internal stream. True sleep comes then. Cadaverous decomposition is, however, accompanied with some slight currents which are neither protoplasmic nor co-ordinated.

About some Particular Cases.

(*a*) *Trance.*—This consists in the diminution of certain currents, and is a more limited sleep than that effected in normal conditions. Hypnotizers avail themselves of several means of fixing or inhibiting currents (compression of the eyes, staring, gazing at a brilliant object, or suggestion, that is, the inhibiting action of the will on some nervous currents of a particular sort).

(*b*) The sleep of nocturnal animals in the course of day is related to the action of light. In Mexico bats have been observed to issue from their dens during eclipses of the sun; gnats flutter in rooms during day-time as soon as all doors are shut so as to leave the apartment in the dark. Everyone has seen that owls close their eyelids whenever a vivid light strikes them.

(*c*) *Muscular Relaxation during Sleep.*—I believe that muscular contractions are due to certain changes in the volume of the protoplasmic alveoli. Rhumbler has demonstrated that such is the possible cause of mytosis, and that the rows of small alveoli, when these are partly emptied, diminish in volume and exercise a strong tension on the centrosomes. The dynamical influence of those changes being wanting when nerves are sleeping, and there are no waves nor modifications in the intra-alveolar pressure, it is clear that muscles must relax.

The same happens in several pathological cases under the influence of fatigue or of certain depressing emotions, etc. This means that I suppose nervous waves to provoke the passage of the alveolar enchylema into the protoplasm of the muscles either by the mechanical action of the shock or by an increase of hydrostatic pressure. I do not deny that the latter have the structure and elasticity required. It will be remembered that the muscular wave moves along the muscles of ants in such a way that it is observable under the microscope. This could not be the case in a homogeneous liquid.

(*d*) Naturalists faithful to the old school would find a remarkable "harmony" in the following fact:—

According to Van Beneden the intestinal worms of bats enter into a period of hibernal sleep at the same time as their hosts. That is to say that the deep protoplasmic currents are delayed both in the host and its parasite by lack of nourishment.

Summary (concerning every living thing).

Nutritive currents are endowed with a very great velocity in active life.

Nutritive currents (sap, blood, protoplasmic currents) are periodically delayed by the want of the reserves expended during the day, and the result is sleep.

The same currents may be less active during the day on account of inaction or of some other cause, and the result is somnolence. This may also be ascribed to nervous excitation.

Currents delayed by the constant action of cold—Sleep in winter.

Currents delayed by an excess of external heat—Sleep in summer.

Currents delayed or even utterly prevented by lack of moisture—Latent life.

General co-ordinated currents definitely stopped by coagulation, poisoning, hemorrhages, asphyxia, etc.—Death.

An Artificial Schematic Organism.

The principal varieties of sleep, life, and activity may be illustrated by an organism which I have constructed. It can be modified and perfected in a thousand ways, and several may be brought into connection. It consists of a damp chamber bounded by walls of cement and gypsum, or a paste of carbonate of lead and linseed oil (skin) with efferent capillary tubes (excretory apparatus). Between the two glasses and the two partitions there are big drops of Bütschli's cytoplasm or "artificial protoplasm" and water. In the middle stands a digestive apparatus formed of thin caoutchouc or of a snake's lung; two tubes of glass serve to keep it open at the ends, and it is made narrower in the middle; it receives food (peptone, water, and some sugar solutions) through one end and expels it through the other. For this purpose the mouth is covered after filling the cavity. The whole is afterwards heated by means of a small oil-lamp, and then cooled or dried, whilst the currents and the osmotic phenomena, the deposits, concretions, etc., are observed. The internal currents and movements are stimulated or paralysed according to the conditions mimicking those called vital. As respiration cannot be imitated, the heat afforded by oxidations may be replaced by that furnished by the small oil-lamp; after all it is exactly the same thing. The two glasses being difficult to unite they may be replaced by Vierordt's glass-box or haematochrometer.

Note.

In a relatively young country, such as Mexico, investigations concerning General Biology are very difficult. Science has fructified here

only for the last twenty or thirty years, and that beneath the shade of a most complete and dispiriting peace. There is a lack of teachers, books, laboratories, and intellectual vigour—the latter chiefly. Consequently, although it would make me happy, I dare not beg for the protection of the learned foreign corporations, considering myself unqualified for it, but I will at least beg that some indulgence be shown regarding the imperfections with which all my works do surely abound.

MEXICO, *April* 30, 1899.

FRESH FACTS.

Pump Benthos. W. P. Hay. "Description of a new species of subterranean Isopod," *Proc. U.S. Nat. Mus.* xxi. 1899, pp. 871-872, pl. lxxxvi. Forty or fifty specimens were obtained from an old well in Irvington, Marion County, Indiana. They were evidently strictly aquatic. The pump in the well drew water from the bottom, and the animals could be obtained only by vigorous work. After capture they lived for some hours in a jar of water, crawling about on the bottom, very much after the manner of *Asellus.* While in the water the swimming feet gently moved up and down with a fanlike motion. Several of the females carried eggs, six or eight of which were sufficient to fill the brood pouch. The species is named *Haplophthalmus puteus.* Other species of the genus are inhabitants of moist situations, such as decaying leaves and wood, in various localities in Europe. It is also closely related to *Scyphacella* (*Haplophthalmus ?*) *arenicola*, which has been found burrowing in the sand in a number of localities along the Atlantic coast of North America.

A Zoological Puzzle. William Morton Wheeler. "The Life-history of *Dicyema*," *Zool. Anzeig.* xxii. 1899, pp. 169-176. The author's observations suggest a new conception of the life-history of *Dicyema*, which has been for a long time a zoological puzzle. He believes that the same *Dicyema* is at first a "nematogen" (or female produced from parthenogenetic ova and producing other females parthenogenetically), and then a "rhombogen" (producing what are called infusiform embryos which arise from fertilised ova and are really males). "As in so many other cases in the animal and vegetable kingdoms the males make their appearance when the conditions of life become unfavourable, viz. after the kidney (of *Octopus*) is well-peopled with Dicyemids and food is less abundant." Mr. Wheeler believes that the structural and developmental peculiarities of the Dicyemids entitle them to a more independent rank than that of an appendix to the flat-worms.

How Young Duckmoles get Milk. V. Sixta. "Wie junge Ornithorhynchi die Milch ihrer Mutter saugen," *Zool. Anzeig.* xxii. 1899, pp. 241-246. Prof. Sixta has been informed by Alois Topič, who lived for many years in Australia, that the mother duckmole lies down on her back, and that the two young ones press the milk out through the sieve-like apertures with their bills. The milk flows into a median groove which is formed by the longitudinal muscles. Until they are 12 cms. in length the young remain in the nest; when they measure 20 cms. they are taken by the mother into the water.

Smell in Birds. Xavier Raspail. "Le sens de l'odorat chez les oiseaux." *Bull. Soc. Zool. France*, xxiv. 1899, pp. 92-102. It is a common statement that while nocturnal birds have a fine sense of smell, the diurnal birds of prey are guided solely by sight. Indeed, in many good zoological works, the sense of smell in birds is said to be almost nil. Against this, Raspail protests vigorously, and cites his observations on rooks, magpies, and blackbirds, which

seem to show that the sense of smell is well developed. He goes the length of saying that birds are endowed with the sense of smell at least equal to that of the dog.

Nuclei of Mammalian Red Blood Corpuscles. A. Negri. "Ueber die Persistenz des Kernes in den roten Blutkörperchen erwachsener Säugethiere," *Anat. Anzeig.* xvi. 1899, pp. 33-38. The student who in his practical examination identifies distinctly nucleated red blood corpuscles as mammalian does not win favour in the eyes of the examiner, and this is perhaps well. But Mr. A. Negri, stud. med., has shown that there is still relevancy in inquiring into the possible persistence of the nucleus in the red blood corpuscles of adult mammals. The persistence of a nucleus has been asserted repeatedly, and, we believe, always given up. Perhaps only Petrone has stood to his guns and maintained *contra mundum* that to say the nucleus is absent is to confess ignorance of the proper method for its discovery. Negri has worked with Petrone's method, but finds that Petrone's "nucleus" is to be found in the embryo along with, but distinct from, the nucleus which is still evident in the red blood corpuscles in intrauterine life.

Urns of Sipunculus. S. J. Metalnikoff. "Das Blut und die Excretionsorgane von Sipunculus nudus," *MT. Zool. Stat. Neapel*, xiii. 1899, pp. 440-447. The strange multicellular ciliated bodies which occur in the body cavity and blood of Sipunculids have been much discussed and variously interpreted. According to Metalnikoff, they arise, in part at least, on the internal walls of the blood vessels, and serve to protect the animal from the ill-effects of hard particles which may be ruptured from the gut into the body cavity. The suggestion of Cuénot and others that the urns by their rapid movements help to compensate for the absence of a heart is also accepted.

Beetles in Self-Defence. L. Bordas. "Les glandes défensives ou glandes anales des Coléoptères," *Ann. Fac. Sci. Marseille*, ix. Fasc. v. pp. 1-45, 2 pls. In this memoir, which our French colleague has been kind enough to send us, it is shown that the majority of beetles (Cicindelidae, Carabinae, Harpalinae, Feroniinae, Brachininae, Dytiscidae, Gyrinidae, Staphylinidae, Silphidae, etc.) possess in the posterior abdominal region a pair of glands, disposed in a cluster or in a tube, producing a secretion which is forcibly ejected in self-defence. These anal or defensive glands belong to the last abdominal segment, and consist of a glandular portion, an efferent canal, a reservoir or receptacle, and an excretory duct.

Devonian Rocks of Arctic Europe. Th. Tschernyschew and N. Jakowlew. "Die Kalksteinfauna des Cap Grebeni auf der Waigatsch-Insel und des Flusses Nechwatowa auf Nowaja-Semlja," *Verhandl. Russ. Kais. Mineral. Ges.* xxxvi. pp. 55-99, pls. vi.-viii. 1899. Many authors have written much on the Palaeozoic rocks and fossils of Waigatsch and Nova Zembla, but their statements have lacked precision, their conclusions definiteness. Two horizons are here determined in Waigatsch. The one, containing *Spirifer waigatschensis*, n. sp. and five other brachiopods, is paralleled with the upper limestones of the Middle Devonian in the Ural, containing *Spirifer anossofi* and *Stringocephalus burtini*. The other, furnishing *Proetus waigatschensis*, *Lichas* (*Dicranogmus*) *lindströmi*, *Leptodomus borealis*, *Spirifer parvulus*, n. spp., appears equivalent to the limestone of Nova Zembla, which contains *Cardiola lehmanni*, n. sp. Other fossils, such as *Orthoceras cinctum*, *O. cf. tentaculare*, *Whitfieldella didyma*, *Leperditia nordenskioldi*, show that this is not older than Middle Devonian.

SOME NEW BOOKS.

EAST AFRICAN SPORT.

Sport in East Central Africa, being an account of Hunting Trips in Portuguese and other districts of East Central Africa. By F. Vaughan Kirby. 8vo, pp. xvi. + 340, with 4 plates. London: Rowland Ward, Limited, 1899. Price 8s. 6d.

Mr. Kirby is already known to the sporting world as the author of "In Haunts of Wild Game"; and the interesting experiences narrated in the latter work naturally lead the reader to expect as many exciting adventures in the new venture. In this matter it may confidently be said that expectation will not be disappointed; the adventures which befell the intrepid author in his pursuit of lions, elephants, hippopotami, and rhinoceros being little short of marvellous, although all bearing the mark of truth. The greater part of the country traversed by Mr. Kirby lies in the provinces of British Central Africa and Portuguese East Africa, and those who follow in his footsteps will doubtless benefit much by the descriptions given of the different routes. It would, however, have been a decided advantage if the publishers could have seen their way to issue an explanatory map, but the price at which the book is sold probably rendered this impossible. In his first work the author showed a tendency to write unduly long and complex sentences; and we are glad to notice an improvement in this respect in the present volume, although in some cases a still further curtailment, both as regards length of sentences and general redundancy of expression, would be desirable.

Much of the volume is taken up by the ordinary routine of marching and camp-life; but in the second half the real sporting adventures are so thickly crowded that almost every page is of thrilling interest. In this part of the Dark Continent at any rate, unless the rinderpest has subsequently done its fell work of destruction, the game is evidently not yet on the verge of extermination.

But Mr. Kirby is something more than the ordinary sportsman, and displays a keen interest in Natural History. This is exemplified by the well written appendix, in which all the larger species of mammals met with during the trip are recorded, with notes on their distribution and habits. In one respect the author displays a curious ignorance, this being his failure to grasp the meaning of the term "type" in Zoology. For instance, on page 338, he falls foul of the editor of the "Royal Natural History" for calling the original white-legged variety of Burchell's zebra the typical form, on account of its not being the one met with commonly at the present day! Of course the editor of the "Royal Natural History" is perfectly right, and his would-be critic, hopelessly wrong.

To those interested in a comparatively little known portion of Africa, Mr. Kirby's volume may be cordially commended, and we may at the same time call attention to the very valuable series of works on African sport and natural history now in course of publication by Mr. Rowland Ward.

THE BRAINS OF MAMMALS.

Handbuch der Anatomie und vergleichenden Anatomie der Centralnerven-Systems der Säugethiere: I. Makroscopischer Theil. By Drs. E. FLATAU and S. JACOBSOHN. 8vo, pp. xvi. + 578, with 7 plates and 126 figs. Berlin: S. Karger, 1899. Price 22 marks.

Perhaps we can bestow no greater praise on this elaborate and bulky treatise (which, by the way, only forms a first instalment of the complete work) than the expression of the wish that it may be found possible to republish it on a reduced scale in English. We say in an abbreviated form on purpose, because in these high-pressure times there is scarcely any one save the specialist who can afford time to wade through the mass of detail brought together by the learned author; and it is important that students of mammals, other than brain-specialists, should make themselves acquainted with the leading facts of the present line of investigation. Although, so far as we are aware, there is no work in English specially devoted to the central nervous system of mammals, we are glad to see the authors of the volume before us confessing their indebtedness to British investigators like Cunningham, Beddard, and Garrod.

The plan adopted by the authors is to take leading representatives of the various mammalian orders in regular sequence and to describe in detail the brain-characters in each, more space being naturally devoted to the complicated brain of the Chimpanzee than is assigned to its simpler representative in the Duckbill or Echidna. One method of illustration that especially commends itself to us is the delineation of the position of the chief cerebral sulci on the outer surface of the skull of the animal to which the brain in question pertains. By this means an excellent idea is gained not only of the relative proportion of the brain to the skull, but also as to the relative complexity of brain-convolution in different animals. At the close of the work are given the general results of the authors' investigations; and some very interesting facts are recorded as to the relation of the volume of the brain to that of the skull, the absolute brain-weight, and the relation of the latter to the corporeal weight. Needless to say that these investigations tend in no wise to a revival of the cerebral classification of Mammals attempted by Owen.

In only one respect have we to find fault with the authors, and this relates to the names employed for some of the animals treated of. It is a well-known complaint on the part of systematists that anatomical and physiological writers are generally remiss in regard to nomenclature, but it is seldom that we encounter such a gross anachronism as the retention of the name *Simia troglodytes* for the Chimpanzee. Several minor errors in nomenclature also occur. And here it is desirable to warn the advocates of radical changes in mammalian nomenclature that such are scarcely ever adopted by non-systematists (who probably never see them), so that instead of promoting uniformity, which is the only justifiable plea for their introduction, such changes in names only lead to worse confusion than ever. The volume closes with a comprehensive list of literature, in regard to which it may be remarked that it is a pity some person with a better knowledge of English than is apparently possessed by the authors was not asked to read the proof-sheets.

The work, when complete, will doubtless long remain the standard authority on the interesting but difficult subject of which it treats.

"OUTLINES."

Outlines of Zoology. By J. ARTHUR THOMSON, M.A. Third Edition, Revised and Enlarged. 8vo. pp. 819, with 332 illustrations. Edinburgh & London: Young J. Pentland, 1899. Price 15s.

Professor J. Arthur Thomson is to be heartily congratulated on the issue of the third edition of this well-known text-book. In the space of 819 pages the author touches upon almost every side of zoological science. As the title of the work explains it is simply "Outlines," and although there is always a danger in treating of the multiplicity of subjects herein contained, we are forcibly impressed with the freshness and clearness with which they are presented.

This is the only zoological text-book in the English language which aims at a complete review of zoological science, and the best evidence that such a work was wanted and is appreciated by teachers and students of zoology, is supplied by the issue of the present edition.

The correlation of structure and function which is emphasised throughout the work is an admirable feature, as also the "up-to-dateness" which cannot fail to stimulate the student.

Many new figures have been added and some corrected. While the revision of the illustrations was taking place it is a pity that some of those which have done duty for so long have not been eliminated, such for instance are Fig. 73 representing the proglottis of a Cestode ("Constructed from Leuckart") in which the nervous system is omitted, Fig. 83 of the reproductive organs of *Lumbricus* (after Hering) in which the ovaries are incorrectly figured, Fig. 150 a "dissection of *Helix pomatia* (mainly after Leuckart") in which the position of the heart is wrongly shown. It is questionable if figures 199 and 215 are worth the space they occupy, while Figs. 234 and 235, representing the urino-genital organs of the male and female frog, would undoubtedly have been more useful if of *Rana temporaria* rather than *R. esculenta*.

In a fourth edition we should like to see the confused account of the renal and reproductive organs of the skate (pp. 496-497) re-written, and the terms Wolffian and Müllerian ducts omitted.

A word must be said in praise of the tabular form of summaries of affinities, etc., in chapter xx., as indeed of those throughout the work, all of which are admirable.

This delightfully written text-book has enjoyed an enviable reputation in the past, and the present edition can only enhance the same.

WALTER E. COLLINGE.

PRACTICAL ZOOLOGY.

Leitfaden für das Zoologische Praktikum. By Dr. WILLY KÜKENTHAL, Professor in Jena. 8vo, pp. vi. + 284, with 172 text-figures. Jena: G. Fischer, 1898. Price, sewn 6 marks, bound 7 marks.

This is intended as a guide for beginners, whether in a properly appointed laboratory or working independently. For the latter there are given many technical instructions, for the lack of which the elementary student so often finds himself at sea. The opening chapter is on apparatus and the way to use it, and contains many useful hints. Thus the author rightly insists on the necessity for drawing on a large scale—"Don't spare paper, but take a fresh page to each drawing." Then follows a chapter on the elements of histology, in which, after an illustrated summary of the various tissues, it is shown how they may be demonstrated. The student is then led through nine phyla of the animal kingdom, beginning with Protozoa and ending with Vertebrata. Each of these is preceded by a systematic synopsis, enabling the student to ascertain

the position of the species under investigation, but of course not intended to supplant the ordinary text-book of systematic zoology. The study is divided into twenty lessons, and at the beginning of each is a short statement of the material and reagents required, followed by a general account of the Class or Order. The directions for the actual dissection and demonstration are clear and straightforward, and are elucidated by a number of figures. Of these illustrations many are original, and due either to the author or to his pupils, Messrs. Th. Krumbach and A. Giltsch. Others are borrowed, and we are glad to note that the original source is given with accuracy; but is not "Fig. 95. Organisation von *Holothuria tubulosa* (aus Lang)" really copied from Milne Edwards and Carus? The drawings are good, they will help to sell the book, and the beginner will be grateful for them. None the less, they may tempt the student to adopt the easier course of lifting them into his note-book instead of drawing from the object before him. And is it not a good training for the student to direct him to the original monographs, and to let him copy the figures (if he does it at all) from the first source of each? There is little in this book to lead the student on, or to disabuse him of the notion that, when he has worked through what is here, he will have as thorough acquaintance with the various types as is needful. The course is professedly an elementary one, and little attention is paid to other methods than those of dissection with scalpel and needle. But even so, it is startling to find *Sepia* taken as the type of a Cephalopod, and yet no description given of the cuttle-bone.

There are so many good books of the kind nowadays, that this one by Professor Kükenthal is not likely to find a large sale outside Germany, even if translated. But it can be recommended as accurate, clear, and adapted to the somewhat narrow limits of an elementary course. F. A. B.

MONTH BY MONTH.

Rambles with Nature Students. By ELIZA BRIGHTWEN, F.E.S. Pp. 221, with many illustrations. London: Religious Tract Society, 1899.

Mrs. Brightwen has published another of her delightful little books of talk about common things. The present volume contains six or seven short chapters for each month, and with just a little help from the treasures of her museum in the barest months the authoress contrives to find interesting subjects throughout the year. In the dull days she gives us pretty and well-illustrated studies of ice-crystals, footprints in the snow, skeleton leaves, birds' feet and skulls, ventriculites, and various other matters. During the brighter months she writes simply and clearly of many familiar insects and flowers, and of some, too, like those in her chapter on "Hidden Lives," that are known only to those whose eyes have been trained to see. Her descriptions are always vivid and interesting, and the practical directions frequently given are clear and simple. Her new book will prove not only helpful and stimulating to those who have already done some work for themselves, but will also be a most comforting guide for such easily-discouraged little people as the twelve-year-old, who abandoned the study of natural history because, as she plaintively said, the beasts never had any habits when she was watching them.

The naturalist's delight in living things for their own sake by no means obscures Mrs. Brightwen's keen appreciation of their practical aspects. Thus we may learn from her chapter on the development of flies what precautions should be taken to protect our meat from bluebottles, from the life-story of the meal-worm how to keep up an unfailing supply of animal food for our cage birds, and she tells us, too, that a tonic beverage may be made from acorn-kernels, and that she was able to express from a fungus, the "maned agaric," a serviceable ink whose qualities were unimpaired after eleven years. The ingenious way in which, by a process of pith-slicing and repeated ironing, she

succeeded in making, from a papyrus in her hothouse, a paper exactly resembling the ancient parchments of the East, commands our highest admiration. But what shall we say of a green satin banner-screen, embroidered with jasmine sprays, of which the starry flowers were simulated by five otoliths of fishes, and the leaves by rose-beetle wings? M. R. T.

A STRANGE MIXTURE.

The Philosophy of Memory; and other Essays. By D. T. SMITH, M.D., Lecturer on Medical Jurisprudence in the University of Louisville. 8vo, pp. 203. Louisville, Ky.: John D. Morton and Co., 1899. Price $1·25.

This work is a collection of essays upon very diverse subjects. How wide is the range a mention of the different titles will indicate. Besides the essay on the Philosophy of Memory, which gives its name to the book, there are articles on the Functions of the Fluid Wedge, the Birth of a Planet, and the Laws of River Flow.

The degree of mental equipment which the author possesses, and the measure of intelligence which he brings to bear upon these subjects may, perhaps, be illustrated in the following manner:—After some 70 pages of argument concerning memory, the author says, "Every animal in every part, every leaf in its pattern of shapeliness," etc., etc., etc., "is now built up and developed by the forces of nature playing on it chiefly from the worlds beyond. It is the little waves of ether, coming mostly from the sun, that build up the plant, and by their ceaseless pelting drive every atom and every molecule to its place" (p. 78). And "The tenderest feelings must have a higher origin . . . than that of the familiar forms of force; and nothing appears as their proximate source except the fading undulations of light as they journey through infinite space—the 'sweet influences of the Pleiades'" (p. 80).

In the essay on the Birth of a Planet the author brings forward several, at any rate plausible, arguments against the nebular theory; but then he concludes, "One might be tempted to suggest . . . that worlds have a season to bring forth, as do animals and plants, and that in their proper times and seasons, fixed in the infinite councils, they drop their ripened fruit of young worlds into space" (p. 136). We are tempted to suggest, knowing the universal solicitude of the British Parliament for all afflicted, that the new Midwives Bill provides for the case of a world in labour. We cannot afford to lose a world through the ministrations even of a celestial Sairey Gamp.

The essay on the Laws of River Flow suffers from association. The author does not suggest "light from the Pleiades," or the "infinite councils" having any controlling influence on river flow. He leaves a volume of water to its own devices, and suggests that it moves, in flowing, "like two equal cylinders revolving spirally on parallel axes in different directions, outward at the bottom, upward at the margins, inward at the top, and downward through the middle."

The movements of a body of water flowing along a channel are evidently most complicated. Whether among other movements it has that which the author suggests might be determined in the laboratory. It should not be difficult to devise a series of experiments adequate for the end in view.

S. S. B.

AN ALPINE GUIDE.

Hints and Notes for Travellers in the Alps. By the late JOHN BALL. A new edition by W. A. B. COOLIDGE. 12mo, 164 pp. London: Longmans, Green & Co., 1899. Price 3s.

The late Mr. John Ball's "Hints and Notes," forming the General Introduction to his "Alpine Guide," is too well known and too highly appreciated

by all visitors to Switzerland, to need more than a reference to the new matter introduced into this edition, which is both interesting and important. The chapter on the geology of the Alps has been practically rewritten by Professor Bonney, and that on the climate and vegetation of the Alps has been expanded by Mr. Percy Groom. In addition to this, Mr. Sydney Spencer adds a new chapter on photography in the High Alps; and the editor contributes one on Life in an Alpine Valley, and an exceedingly useful Glossary of alpine terms.

It will be seen, therefore, that the volume forms a complete *vade mecum* for visitors to the Alps, whether climbers or ordinary tourists, its small and compact size fitting it admirably for the pocket or the knapsack.

The chapter on "Life in an Alpine Valley," should be read by everyone who cares to know anything about the social condition of the people among whom he is travelling. It treats of the daily manner of life of the dwellers in the mountain valleys, the customs regarding the ownership of landed property, the rights of use of the "Alps," and other details. The limitation which the editor himself lays down should, however, be borne in mind by the reader, that his description applies mainly to that portion of Switzerland with which Mr. Coolidge's residence at Grindelwald has made him specially acquainted. Thus the statement that "spinning and weaving have almost disappeared" from the mountain châlets does not apply to the Ausser Rhoden of Canton Appenzell.

A. W. B.

LIQUID GASES.

Liquid Air and the Liquefaction of Gases: Theory, History, Biography, Practical Application, Manufacture. By T. O'Conor Sloane, Ph.D. 8vo, 365 pp., with illustrations. London: Sampson Low, Marston, & Co.

This little book gives a readable account of the work done on the liquefaction of gases, which has of late met with so much success, and has attracted so much popular attention. The author begins with a short exposition of the facts and scientific principles underlying the obvious phenomena of change of physical state, and describes the various appliances necessary for the measurement of very low temperatures. In succeeding chapters he shows the historical development of the subject, beginning with the foundation of the Royal Institution in 1799, reviewing briefly the early work of Northmore and Faraday, describing in greater detail the life and labours of Pictet and Cailletet, finally to deal with the "moderns" Dewar, Tripler, Linde, and Hampson. The biographical notices are interesting, and many of them are accompanied by good portraits. Chapters on experiments with liquid air and on the practical applications of very low temperatures conclude the volume. It is gratifying to learn that the author in no way countenances the absurdly exaggerated accounts that have appeared recently in many newspapers regarding liquid air as a source of energy. While he says (p. 356), "Liquid air, if it could only be produced cheap enough, would represent an ideal substance for the production of energy," he has carefully stated on a previous page (p. 72) "The trouble is that to produce liquid air we have hitherto been obliged to expend a great deal more available energy than we can utilise of normally unavailable energy by its gasification."

Ch.

HISTORY OF CHEMISTRY.

A Short History of the Progress of Scientific Chemistry in our own Times. By William A. Tilden, F.R.S. 8vo, x. + 276 pp. London: Longmans, Green, & Co., 1899. Price 5s.

Professor Tilden in his preface says, "In the following pages I have endeavoured to provide for the student such information as will enable him to

understand clearly how the system of chemistry, as it now is, arose out of the previous order of things; and for the general reader, who is not a systematic student, but who possesses a slight acquaintance with the elementary facts of the subject, a survey of the progress of chemistry as a branch of science during the period covered by the lives of those chemists who were young when Queen Victoria came to the throne." This self-imposed task has been admirably accomplished. In brief compass he sets before the reader an easy account of the most striking facts and theories of modern chemistry in their origins and in their final development. Thermochemistry, spectrum analysis, the periodic system of the elements, the synthetic production of dyes, drugs, and explosives, stereochemistry, and the action of ferments, all receive simple and adequate treatment. To both student and general reader the book can be warmly recommended. CH.

A MUSEUM HANDBOOK.

The Manchester Museum, Owens College. General Guide to the Natural History Collections. By W. E. Hoyle. 8vo. pp. 78. Manchester Museum, Publication 28, 1899. Price 6d.

Distinctly a Museum Handbook, in that it guides the visitor, gently but firmly, through the museum from case to case, from minerals and geological phenomena, through the array of fossils stratigraphically disposed, then along the animal collections in the order of their arrangement (not always harmonious with the text-book), and finally through the botanical exhibits. Those who wish for a cut-and-dried classification will find in the form of appendices: "A. List of the principal divisions of the Earth's Crust;" "B. List of the principal divisions of the Animal Kingdom," with a typical example of each class mentioned in the vulgar tongue; and C. the same for the Vegetable Kingdom. In the monstrously difficult task of writing in simple language an accurate and not uninteresting summary of the Animal Kingdom Mr. Hoyle has achieved as much success as is possible. All the same, why does Mr. Hoyle say (p. 8) that the Devonian Crinoids "were of the type known as Cystids"? The division of the Crinoidea generally (p. 56) into "sea-lilies" and "feather-stars" is due of course to the two volumes of the Challenger Report. It is a book-binder's classification. The account of the Geological divisions is as good as one could hope to find in a score of pages. But the two pages devoted to the Mineralogical and Petrological Collection ought to be multiplied by at least ten, or else omitted. It is a pity they should form an opening to the Guide. The compression of the guide to the Botanical Collection into seven pages may have been enforced; if so, it is to that cause we will charitably ascribe the appearance of such unexplained terms as "saprophytic," "prothallium," "carpellary," "dichotomous," and the sweet little "bulbils." These fancy words are not in the picture with the rest of this excellent handbook. F. A. B.

THE NOTES OF BIRDS

The Cries and Call-Notes of Wild Birds. A popular Description of the Notes employed by our commoner British Birds in their Songs and Calls. With Musical Illustrations. By C. A. Witchell, Author of "Evolution of Bird Song," etc. 8vo, pp. xi. + 84. London: L. Upcott Gill, 1899. Price 1s.

One of the greatest charms of field ornithology is supplied by the various cries and songs uttered by different groups and species of birds. Much attention has been devoted to this subject by our continental *confrères*, some of whom have excelled in their skill in rendering upon paper the love-notes and

alarm-cries of bird-colonies. In the present case, an English ornithologist furnishes an interesting collection of his own rendering of bird-notes. Probably no two persons would express the more difficult notes in exactly the same way, but an approximation to truth is by no means impossible. Mr. Witchell has devoted so much loving labour to the study of his favourite subject, that many people besides professed naturalists will welcome the present volume, and find that it stimulates their endeavours to acquaint themselves with all the different notes that enliven our shores and forest haunts. The treatise is popularly written, and the songs of a good many birds are expressed in musical notation.

H. A. Macpherson.

The latest number of the *Transactions of the British Mycological Society* contains a summary of the Fungus Foray held at Dublin in September 1898, and the papers read at the meetings. The Foray must have been conducted with energy, for 160 species were added to an already existing list of 830 species for the counties of Dublin and Wicklow. In the report useful references to suitable neighbourhoods and to the local literature will be found. Among the more important papers are those by Dr. C. B. Plowright, who acted as president of the meeting. His address on the Agaricini, and a contribution on "New and rare British fungi," are useful and practical. A summary of the recent work of Eriksson, of Stockholm, on the Uredineae of cereal crops is particularly valuable, because, during the past year, that author has given articles on the same subject to almost every existing botanical magazine, till he has landed the student in a hopeless maze of references; a clear summary like this one was much needed. The Dublin members, Mr. Greenwood Pim and Dr. M'Weeney, have contributed useful papers, the latter throwing light on two sclerotium diseases of the potato. Two papers in the number before us are merely reprints of the British Association reports of the 1898 meeting; they are both rudimentary notes on laboratory work done at Cambridge, and it seems absurd that such should be presented in the same month to the British Association and again to the Mycological Society; still more superfluous that one should meet them here for at least the fourth time in the literature of botany. Dr. Plowright gives obituary notices on two eminent fungologists—Rev. Canon Du Port and Mr. H. T. Soppitt, with good portraits.

We have received the first number of the *Polyclinic*, being the journal of the Medical Graduates' College, London, a journal which does not at first sight much concern readers of *Natural Science*, however strongly they may in other capacities sympathise with the aims of this admirable institution. Yet as we turn over the pages with a biological eye, we feel impressed by the fact that while knowledge is manifold there is only one science. Sir William Broadbent, with the progress of science for his keynote, Mr. Jonathan Hutchinson, with the motto, "'Tis the taught already that profits by teaching," Dr. Miller Ord, with the proverb "Docendo discimus," expound the aims of the college; and as we pass to courses of lectures we see "functions of the nervous system," "family history in nervous disease," "diseases of animals," "experimental teratogeny," "dissolution of heredity," "physiology of germinal life," and much more, which shows that the journal has much common ground with ours. Floreat.

The June number of the *Journal of School Geography* contains, *inter alia*, articles on Southern California, by Mr. J. F. Chamberlain; on the geographical and geological exhibition at Springfield, Mass., by Professor R. E. Dodge; on pressure, winds, and rainfall over the British Islands by Dr. A. J. Herbertson. Among the exhibits referred to are the great relief map of the United States, showing the curvature of the globe, and with the glacial ice-cap, two relief globes, the Spruner-Bretschneider charts, illustrating the development of Europe from 350 A.D. to the close of the Napoleonic wars, the series of 37 Charakter-

Bilder, by Hölzel of Vienna, the forestry maps of Sargent, showing the distribution of trees in North America, and many other items of importance which suggest, like the journal itself, the great progress at present being made in the science and teaching of geography.

In *Science* of June 23 Prof. R. W. Wood describes his diffraction process of colour-photography, which is really a variation of the three-colour method; and Prof. E. Thorndike discusses the mental fatigue of school work, furnishing additional data which render more probable his previous conclusion that "the mental work of the school day does not" [at the time] "produce any decrease in the ability to do mental work."

The eye of the Amphipod Crustacean *Biblis serrata* receives attention at the hands of Dr. S. D. Judd in the May issue of the *Proc. Biol. Soc. Washington*, and is found to be remarkably different from the corresponding organ of *Gammarus*. It appears to be a compound eye constructed on the general plan of an ocellus, but furnished with a space which may be the functional representative of the space occupied by the vitreous humour in the vertebrate eye. Further investigations are, however, needed before the full significance of all parts of this organ can be determined.

The Alaskan Moose, or Elk, has long been known to be the largest representative of its kind, and it appears to be mainly on this feature that Mr. G. S. Miller relies in describing it as a new species (*Alces gigas*) in the recent issue of the serial last quoted. Most English writers regard all the living representatives of the Elk as referable to a single wide-spread species. In recognising three specific forms in what is essentially one and the same animal, Mr. Miller shows the value to be attached to species recently named by American writers among the smaller Mammals.

Prof. Weismann's essay on regeneration appeared contemporaneously in *Natural Science* (in English) and in the *Anatomischer Anzeiger* (in German). A reprint of the German edition has been published in pamphlet form by Mr. Fischer of Jena, to whom we are indebted for a copy. It is entitled "Thatsachen und Auslegungen in Bezug auf Regeneration," occupies 31 pages, and costs 60 pfennigs.

OBITUARY.

SIR W. H. FLOWER, K.C.B. (1831-1899).

It is with sincere regret that we have to record the death of Sir William Henry Flower, which took place at his residence in Stanhope Gardens, on the afternoon of Saturday, July 1, after a protracted period of failing health. It was owing to this ill-health that he resigned, in August last, the Directorship of the Natural History Branch of the British Museum; and although a residence during the past winter in the Riviera led to a temporary improvement, on his return to Stanhope Gardens in May it was but too evident that no permanent benefit had taken place in his condition, and that the end could not be far distant. After a short rally, a serious relapse occurred on the Thursday preceding his demise, which resulted in a fatal attack of pneumonia.

Sir William was the second son of the late Edward Fordham Flower, of Stratford-upon-Avon, Warwickshire, by his wife, Celina, daughter of the late John Greaves, of Radford, Warwickshire, and was born on November 30, 1831, at his father's residence, The Hill, Stratford-upon-Avon. The latter part of his education was conducted at University College, London, where he went through the ordinary course of medical study, eventually qualifying as a surgeon. We believe we are right in saying that the career of an army-surgeon was not his original intention, but that the need of additional surgeons for the army induced him to volunteer at the outbreak of the war for service in the Crimea. At any rate, he was at that time attached, in the capacity of assistant-surgeon, to the 63rd regiment, with which he served throughout the long campaign, receiving at its close the Crimean medal, with the Alma, Inkerman, Balaclava, and Sebastopol clasps, and also the Turkish medal. With the close of the war his services as an army-surgeon also came to an end; and after his return to England he was appointed in 1859 Assistant-Surgeon and Demonstrator in Anatomy at the Middlesex Hospital. Mr. Flower (as he then was) did not, however, long retain this post, which he vacated in 1861 to take up the more congenial duties of Conservator of the Museum of the Royal College of Surgeons, a position which he occupied till his transference to the British Museum in 1884. In the meantime (1870) he was, however, chosen to succeed Owen as Hunterian Professor of Comparative Anatomy and Physiology to the College—a post which he likewise held till the severance of his official connection with the College. The resignation in 1884 of Sir Richard Owen caused the Directorship of the Natural History Branch of the British Museum to become vacant; and to this important position Professor Flower was shortly afterwards appointed. During his tenure of the Directorship, he was successively gazetted C.B. in 1887, and K.C.B. in 1892. In the ordinary course of events, Sir William's connection with the Museum would have terminated on his attaining the age of sixty-five in 1896. But, on the earnest recommendation of the Trustees, the Treasury was induced to waive the age-disqualification in his case; and it was during this unexpired period of extension of service that Sir William was compelled by ill-health to tender his resignation.

In addition to the distinctions conferred by his Sovereign, Sir William Flower was the recipient of numerous other honours from academic and scientific bodies. In 1864, he was elected to the Fellowship of the Royal Society, from whom, in company with Lord Rayleigh, he received the award of a Royal medal in 1882. He served on the Council of the same Society for three separate periods, namely 1868-1870, 1876-1878, and 1884-1886; and from 1884 to 1885 filled the office of a vice-president. He was a Fellow of the Royal College of Surgeons of London. The degrees of D.C.L. and LL.D. were

conferred upon him respectively by the Universities of Oxford and Cambridge; and he was also the recipient of those of D.Sc. and Ph.D. So far back as 1851 he became a Fellow of the Zoological Society, of which body he was elected president in 1879—an office he held at the time of his death. From 1883 till 1885, Sir William also occupied the presidential chair of the Anthropological Institute; while in 1887 he served in the same capacity at the meeting of the British Association, having presided over the section of Biology at the meeting of 1877, and that of Anthropology in 1881. He was also President of the section of Anatomy at the International Medical Congress at its London meeting in 1881; and it was solely due to ill-health that he was prevented from presiding over the International Congress of Zoology held last year at Cambridge. Both the Geological and the Linnean Societies of London claimed Sir William as a Fellow.

As examples of his devotion to his own work, it may be mentioned that it is within the knowledge of the present writer, that Sir William refused both the Presidency of the Royal Society, and a seat in the Senatus of London University (in succession to Huxley), on the ground that they would interfere with his official duties.

From his very earliest days Sir William Flower displayed a marked love and inclination towards natural history studies; and in his last work, "Essays on Museums" (which is a collection of articles compiled while incapacitated by illness from more severe labours), he takes the public into his confidence to tell them how he first began collecting and arranging zoological specimens in early boyhood. With his appointment to the Museum of the College of Surgeons, opportunities for cultivating that branch of zoological science he loved best, namely, the anatomy and classification of mammals (inclusive of man), were abundant, and good use was made of them. Nearly every portion of the osteological collection of the College still bears the impress of his work; the series of human skulls and skeletons having been vastly increased during his tenure of office.

A permanent record of his zeal in augmenting and classifying the Hunterian collection is afforded by the two volumes of "Catalogues" compiled by him, with the assistance of Dr. Garson, during his tenure of office; one of these, published in 1879, being devoted to the osteology of man, while the second (1884) treats of that of other mammals.

During his tenure of the Hunterian chair, Professor Flower regularly delivered the annual course of lectures; the substance of the first series of these being expanded into the now well-known "Introduction to the Osteology of the Mammalia," the first edition of which appeared in 1870, and the third (revised with the assistance of Dr. H. Gadow) in 1885.

For several years after his appointment to the British Museum, Sir William's attention (in addition to the routine work of his office) was largely occupied with the formation and arrangement of the "Index Museum," which now occupies the bays on the sides of the central hall; while he was also engaged with the acquisition and mounting of the interesting specimens exhibited in the cases standing in the hall itself. When, however, the office of Keeper of the Zoological Department was held by him conjointly with the Directorship, Sir William in due course determined to rearrange at least the Vertebrate Galleries of the Museum according to his own ideas—a work which is still in progress. As is well known, it was his idea that no specimens should be exhibited in a Museum to the public which do not actually teach something; and he was above all urgent as to the necessity of explanatory labels, which he regarded as of almost more importance than the specimens themselves. The results of his plan are now exhibited in the Mammal and Bird Galleries.

Although a diligent student of the structure of mammals belonging to all orders, Sir William's special favourites were undoubtedly man on the one hand and whales and dolphins on the other. And his last efforts during his tenure

of the Directorship were devoted to the completion of the life-size series of models of the latter animals, which now form such an attractive feature of the Museum, and also to the formation of an anthropological gallery which should worthily head the zoological series of the museum. Fortunately, he was enabled to witness the opening of the new whale gallery, which took place on Whit Monday of last year; but the comparatively advanced stage now reached by the anthropological series has been the work of other hands in the enforced absence of the originator.

With regard to the general scope and importance of Sir William Flower's scientific work, it is perhaps too early to form an exact opinion. The anatomy, classification, and distribution of the Mammalia undoubtedly formed his favourite themes; and it is largely to his influence and writings that our conceptions of the mutual relations of the different members of the class are due. Of course he was not infallible, as the present views as to the relationship of the marsupials to other mammals alone sufficiently attest. But he was remarkable for his devotion to accuracy; and the pains he would devote to the elucidation of small obscure points are well worthy the imitation of many of his more impetuous followers. Although no grand discovery or great generalisation is associated with the name of Flower, the amount of solid zoological work he has done, and, above all, the revolution which he has brought about in our conceptions of what a museum should be, cannot fail to have a marked influence on his successors for many years to come. We have not yet noticed that, in addition to being a zoologist, Sir William was also a most competent palaeontologist. And yet to him such a disassociation of ideas as these terms imply would have been in the highest degree repugnant, for it was a dominant idea of his that palaeontology is but the zoology of the past, and that the two subjects should be treated as one. This combination of palaeontological and zoological knowledge gave him a far wider conception of the relations of the various groups of the animal kingdom than is held by many of his contemporaries; and, although the force of circumstances prevented its accomplishment, it was his earnest desire to see, so far as practicable, the amalgamation of the recent and extinct specimens exhibited to the public in the great institution confided to his charge.

Although the number of scientific memoirs which stand in his name is very large, Sir William Flower is known to the general public by comparatively few works. Allusion has been already made to the "Catalogues" of the Museum of the Royal College of Surgeons and to the "Osteology of the Mammalia." To the ninth edition of the "Encyclopaedia Britannica," Sir William contributed the important article "Mammalia," as well as a number of minor articles on various representatives of the same group. These articles, together with a few by other writers, were subsequently, with the aid of the present writer, collected and expanded, so as to take the form of a systematic treatise published under the title of "An Introduction to the Study of Mammals" (1891). Later on in the same year appeared a little volume on "The Horse," in the "Modern Science" series; while the above-mentioned "Essays on Museums and other Subjects connected with Natural History" was published, under saddening circumstances, only last year. To allude to any of the numerous memoirs on technical subjects is obviously impossible on this occasion. Although somewhat reserved, and, perhaps, even occasionally cold in manner, Sir William Flower was greatly esteemed and beloved by a large circle of friends, both scientific and otherwise. When once the thin veneer of reserve was penetrated, no man could be kinder; and the trouble and attention he would devote to all who claimed his assistance were almost inexhaustible. To the present writer (if he may be permitted to say so) the loss is a very real and a very personal one. His first recollection of Sir William was in the Cambridge Natural Science Tripos of 1871, when the candidate little thought that he would one day be asked to join the (apparently) stern examiner in writing a treatise on one of the subjects of examination.

R. Lydekker.

NEWS.

THE following appointments have recently been made :—Captain W. de W. Abney, C.B., to be principal assistant secretary of the Science and Art Department; Dr. G. Agamennone, as director of the Geodynamic Observatory at Rocca di Papa, near Rome; Joseph Barrell, as instructor in geology in Lehigh University, South Bethlehem, Penn.; Miss Annie J. Barrows, as assistant in zoology at Smith College, U.S.A.; Dr. Tarleton H. Bean, as director of forestry and fisheries on the U.S. Commission to the Paris Exposition of 1900; Dr. C. Benda, privat docent in the University of Berlin, nominated professor; E. A. Bessey, to be assistant vegetable pathologist in the United States Department of Agriculture; Dr. J. Warwick Brown, as external examiner in zoology in the University of Aberdeen; Dr. E. Wace Carlier, as professor of physiology at Birmingham; J. F. Collins, curator of the herbarium in Brown University, U.S.A., to be instructor in botany there; John G. Coulter, as instructor in botany at Syracuse University; Ulric Dahlgren, to be assistant professor of histology in Princeton University; Dr. J. Dewitz, as resident assistant of the *Concilium Bibliographicum*, whose new address is 38 Eidmatt Strasse, Zürich; Dr. Oliver L. Fassig, as instructor in climatology in Johns Hopkins University; Dr. John Gifford, as assistant professor of forestry at Cornell; Ulysses S. Grant, as professor of geology in the North-Western University; Dr. A. J. Herbertson, as lecturer on physical geography at Oxford; Dr. Robert Tracy Jackson, assistant professor of palaeontology in Harvard; Dr. Bengst Jöhnsson, professor of botany at the Academy at Lund; Sir George W. Kekewich, to be secretary of the Science and Art Department in room of Sir J. F. D. Donelly retired; Dr. B. F. Kingsbury, as assistant professor in histology and embryology at Cornell; Dr. L. Lalry, as correspondent to the *Concilium Bibliographicum* of Zürich; Professor Malcolm Laurie, as external examiner in zoology in the University of Glasgow; Mr. F. R. Lillie, as professor of biology at Vassar College; Miss Florence M. Lyon, Ph.D., as assistant in botany at Smith College, U.S.A.; Dr. R. S. Macdougall, as lecturer on botany at the Heriot-Watt College, Edinburgh; Dr. Rudolf Martin, as professor extraordinarius of anthropology in Zürich; Dr. E. B. Matthews, advanced to the position of associate professor of petrography and mineralogy at Johns Hopkins University; Mr. E. A. Minchin, as professor of zoology at University College, London, in succession to Professor Weldon, now of Oxford; Dr. G. Poirault, to succeed Naudin as director of the botanical laboratory for higher instruction at the Villa Thuret, Antibes; Dr. Adalar Richter, professor extraordinarius of botany in the University of Klausenburg; Miss W. J. Robinson, as instructor in biology at Vassar College; Dr. Alfred Schaper, to be assistant professor of histology at the Harvard Medical School, Boston, Mass.; Dr. Frank Schlesinger, as an observer in the U.S. Coast and Geodetic Survey; W. E. D. Scott, curator of the ornithological collections of the Green School of Science in Princeton; Dr. G. B. Shattuck, advanced to the position of associate in physiographic geology at Johns Hopkins University; M. V. Slingerland, as assistant professor in entomology at Cornell; Dr. Streckelson, privat docent for geography in the University of Basel; Dr. F. Strong of Yale, to be president of the University of Oregon; Professor Ph. van Tieghem, to the chair of the biology of cultivated plants at the National Agronomic Institute, Paris; Dr. Tobler, privat docent for mineralogy in the University of Basel; Dr. R. von Wettstein, to be professor of botany in the University of Vienna; Dr. Gregg Wilson, as lecturer on biology at the Royal (Dick) Veterinary College, Edinburgh, and on zoology at the Heriot-Watt College, Edinburgh; J. B. Woodworth, as instructor in geology in Harvard University.

Mr. G. A. Stonier has been appointed specialist in mining under the Geological Survey of India. Mr. Stonier holds the De la Beche medal for mining at the Royal School of Mines, London, of which institution he is an associate. He has had a wide experience in New South Wales, where he was employed as geographical surveyor, and was for several years a member of the Government Prospecting Board.

Dr. Adolph Fick, professor of physiology in the University of Würzburg, has resigned at the age of 70 years.

The Royal Commissioners for the Exhibition of 1851 have approved the nomination by the University College of North Wales of Mr. Robert Duncombe Abell, B.Sc., to a Science Research Scholarship of the value of £150 a year. Mr. Abell is about to enter the University of Leipzig, where he proposes to engage in research under the direction of Professor Wislicenus.

Mr. James Muir, instructor in Agriculture to the Somerset County Council, has been awarded the prize of 500 guineas offered by the sulphate of ammonia committee for the best essay on the utility of this salt in agriculture.

The Isidore Geoffroy Saint Hilaire Grand Silver Medal of the Société nationale d'acclimatation de France, has been awarded to Prof. Cossar Ewart for his breeding experiments (in reference to which he has also received the Neill Prize from the Royal Society of Edinburgh), and to Miss Ormerod for her entomological work.

The University of the Cape of Good Hope has conferred the honorary degree of D.Sc. on Mr. Alexander W. Roberts, of Lovedale, who has interested himself in astronomical observations there.

Yale University has conferred the degree of LL.D. on Prof. C. S. Minot, and Hobart College on Prof. W. K. Brooks, two of the most outstanding representatives of biology in America.

Prof. H. A. Pilsbry, of the Philadelphia Academy of Natural Sciences, whose work on Mollusca is familiar to students, has received the degree of Doctor of Science from the University of Iowa.

The following have been elected foreign members of the Royal Society:—Prof. L. Boltzmann, of Vienna; Dr. Neumayer, of Hamburg Observatory; Dr. Anton Dohrn, of Naples; Prof. E. Fischer, of Berlin; and Dr. M. Treub, of Buitenzorg Botanical Gardens.

Sir W. T. Thiselton Dyer, K.C.M.G., F.R.S., has been elected to an honorary studentship at Christ Church, Oxford.

The first Nobel prizes in physics, chemistry, medicine, literature, and for the promotion of peace, each of the value of 15,000 kroner (about £2500), will be conferred in 1901, on the 18th December, on the anniversary of Nobel's death. Any one making application for one of the prizes is thereby excluded.

We are glad to learn that Mr. Oldfield Thomas has returned to the British Museum (Nat. Hist.) completely restored to health.

Prof. Angelo Mosso has gone to America to deliver a lecture on the "Psychic Processes and Movement" at the anniversary celebrations at Clark University, Worcester, Mass.

Prof. W. C. Brögger, of the University of Christiania, has accepted an invitation to deliver the second course of the George Huntington Williams memorial lectures at the Johns Hopkins University in April 1900. Prof. Brögger is the most prominent Scandinavian geologist, and is well known for his memoirs upon the geology of Southern Norway. He will lecture upon modern deductions regarding the origin of igneous rocks. The first course was given two years ago by Sir Archibald Geikie on the "Founders of Geology."

Science reports the following gifts and bequests:—Mr. B. N. Duke has within the year given $183,000 to Trinity College; an anonymous donor has offered $25,000 for a biological laboratory for Vassar College, on condition that an equal sum be raised; according to the will of Mr. Jeremiah Halsey, the Norwich Free Academy receives nearly $100,000, and Trinity College, Hartford, $20,000; the Rev. H. Latham, of Cambridge, has given £2000 for the proposed Sedgwick Memorial Museum; Miss S. Dyckmann, $300 for a zoological scholarship in Columbia University for the present year; Dr. D. K. Pearson, $125,000 to Olivet College; Oberlin College has received $50,000 for a chemical laboratory, and two other anonymous gifts of equal amount; the late R. C. Billings of Boston left $100,000 to the Massachusetts Institute of Technology, and $50,000 for scholarships, besides $100,000 to the Boston Museum of Fine Arts.

We learn from *Science* that Mr. Charles H. Senff has given $5000 to the zoological department of Columbia University, which will be in part used for the publication of a memoir on *Polypterus*, to be undertaken conjointly by Messrs. Bashford Dean, Harrington, M'Gregor, Strong, Herrick, and Wheeler. Messrs. Harrington and Sumner hope to make a second expedition to the Nile in search of the fish. Prof. E. B. Wilson's recent efforts to obtain the eggs were disappointed.

A compromise has been effected in regard to the contested will of Dr. Robert Lamborn, and the Philadelphia Academy of Natural Sciences will receive over 300,000 dollars, or half of the testator's bequest.

In *Science* of June 30 there are details of the magnificent endowments of the Leland Stanford Jr. University, said to be the richest University in the world. Mr. Stanford left $2,500,000 in cash to the University, Mrs. Stanford deeded her own private fortune of about a million dollars, and has recently transferred the residue of the estate, which would probably bring in the market about $13,000,000.

At the second of the two annual conversazioni of the Royal Society on June 21, Prof. E. Ray Lankester exhibited collections of mosquitoes received at the Natural History Museum for study in reference to the connection between mosquitoes and malaria; Dr. P. Manson exhibited the malaria parasite; Messrs. Walter Gardiner and A. W. Hill showed intercellular bridges in plant tissues.

The Geologists' Association is the real centre of geological activity in London, in that it practically demonstrates the science in the field, and thus is an educational institution of real value. It is as active as ever in making excursions to places of geological interest in England, and has for the fourth time visited the Continent. Last Witsun, Dr. Barrois took a large party over the Brittany district, seeing to every detail of interest and comfort in the most careful way. The long excursion will be spent in Derbyshire from August 3 to 9 under the general guidance of Mr. Arnold-Bemrose, and promises great things for those especially interested in matters carboniferous.

At a meeting of the Royal Society of Edinburgh on July 17, Sir John Murray gave an interesting account of the progress which has been made in the hydrographic survey of Scottish lakes conducted by Mr. Pullar and himself. The biological contrast between the deep and shallow lakes was touched on, and its probable partial dependence on differences of temperature was hinted at. Dr. Hepburn exhibited a simple "osteometric board" for the more accurate and uniform measurement of bones.

At a meeting of the Royal Society of Edinburgh on July 3, Dr. Hepburn submitted an improved form of craniometer for the measurement of the transverse, vertical, and antero-posterior diameters of the cranium. Dr. Hepburn claimed that by means of this improved instrument measurements of the cranium would be more mathematically accurate, and that fully a dozen more measurements might be taken by means of it than had hitherto been

taken in connection with the skull. In Dr. Hepburn's instrument a graduated bar has been arranged to present zero at its centre, from which the figures proceed in duplicate in opposite directions. Opposite the centre of the graduated bar a straight pair of callipers has been introduced. Dr. Hepburn stated that, so far as he was aware, this was the only form of callipers to which the principle of a third limb had been applied. At the same meeting Professor Sir William Turner gave communications on the Craniology of the People of the Empire of India, the Hill Tribes of the North-East Frontier and the People of Burma, and on Decorated and Sculptured Skulls from New Guinea.

At the annual general meeting of the Marine Biological Association, held in the rooms of the Royal Society on June 28, the president, Prof. E. Ray Lankester, in the chair, it was noted that seventeen naturalists and eleven students had worked in the laboratory during the past year.

The Science Section of the Women's International Congress was held in the Westminster Town Hall on June 29, and Mrs. Ayrton occupied the chair. Astronomy was represented by Mlle. Klumpke from the Paris Observatory; geology by Miss Raisin, of Bedford College; chemistry by Miss Dorothy Marshall, of Girton; bacteriology by Mrs. Percy Frankland; and biology by Miss Ethel Sargant.

The forty-eighth meeting of the American Association for the Advancement of Science will be held at Columbus, Ohio, from the 21st to the 26th of August, under the presidency of Prof. Edward Orton. Ten societies in affiliation with the Association will meet at the same time.

The fourth international congress of Psychology will be held at Paris from the 20th to 25th August 1900, under the presidency of Prof. Th. Ribot. Prof. Ch. Richet will be vice-president, and Pierre Janet general secretary.

It is a cause for much gratification that the Government has conditionally promised £45,000 for the Antarctic expedition. This still leaves much to be raised, since the best authorities declare the minimum necessary to be £100,000. The Queensland Parliament is to be asked for £1000.

The Liverpool School of Tropical Diseases sends out their newly appointed lecturer, Major Ross, to the West African Coast to investigate malaria and other diseases.

The New Mexico Biological Station in charge of Mr. T. D. A. Cockerell is being conducted this summer at Las Vegas. Geological, anthropological, and botanical, as well as zoological, work is being carried on.

Col. W. S. Brackett, of Peoria, Ill., has organised an expedition of twelve mountaineers to explore the geological features of the almost unknown region between Buffalo Hump, in Idaho county, and the Nez Pierce Pass, in the Bitter Root range.

The United States Fish Commission is about to send out an expedition on the "Albatross," in charge of Prof. Agassiz, to explore portions of the Pacific Ocean. Some of the islands to be visited are the Marshall, Society, Friendly, Fiji, and Gilbert groups. It is expected that the trip will require eight months. The party will leave San Francisco in August.

There are already four polar expeditions under way, or almost ready to start, and to these must soon be added that of Capt. Bernier, a Frenchman. His course will be toward Franz Josef Land, for the part lying to the east of Cape Mary Harmsworth. After pushing on as far north as possible, he will disembark with all the provisions, dogs, reindeer, sledges, etc. He intends to pass the winter at Petermann's Land, and at the first opportune moment to make a dash for the pole.

Prof. W. A. Setchell, of the University of California, and some other botanists have gone on an expedition to study the flora of the Aleutian Islands.

Among those who have gone Arctic exploring are Professor W. Libbey, of Princeton, and Dr. R. Stein, of the U.S. Coast and Geodetic Survey.

Those interested in Antarctic exploration look forward with eagerness to the International Congress of Geographers in Berlin, when Sir John Murray, Sir Clements Markham, Dr. Nansen, Prof. von Drygalski, and others will meet and confer.

The Union Pacific Railway Company arranged in June a geological and palaeontological excursion to the fossil fields of Wyoming under the general direction of Prof. Knight, of the University of Wyoming.

It is noted in *Science* and elsewhere that Nansen has resolved to organise an Antarctic expedition for 1902, in which he will endeavour to supplement the work of the British and German expeditions.

On June 27 Prof. Virchow opened the Virchow Pathological Museum in Berlin, which houses his magnificent collection of specimens.

A pathological laboratory is to be erected at Oxford, the curators of the university chest having authorised an expenditure of £10,000, in addition to £5000 from an anonymous member of the university.

According to the *American Geologist*, the Minnesota Academy of Natural Sciences will send to the Greater American Exhibition at Omaha a collection illustrating the natural history of the Philippines.

The Dresser Collection of Birds has, we learn, been acquired by the Manchester Museum. Neither trouble nor expense were spared by the author of the "Birds of Europe" to make the collection as complete as possible, and more particularly to make it a working collection, and numerous specialists who have had the privilege of making use of it have united in expressing their opinion of its value in this particular direction. In addition to the European birds and the allied species from the Palaearctic region generally, it contains the materials used by Mr. Dresser in preparing his monographs on the bee-eaters and the rollers. As regards the extent of the collection, there are of bee-eaters about 30 species and 155 specimens, and of rollers 26 species with 112 specimens, whilst the Palaearctic collection contains from 850 to 900 species, or more according to the British Museum catalogue. When it is remembered that in almost every instance these forms are represented not merely by one skin, but by several showing the differences of plumage due to sex, age, and local variation, it will be readily believed that the collection includes about 10,000 specimens. There are several types and numerous rarities, among which may be mentioned two specimens of the rosy gull, whose nesting-place was discovered by Nansen in Franz Josef Land, and two Labrador falcons. The skins have all been carefully selected, and the collection has been accurately labelled, all particulars as to habitat and other details being recorded. Many specimens have been compared with rare types and noted as agreeing with them; others are the first or the only recorded specimens that have occurred within the western Palaearctic area. Enough has now been said (we quote the *Manchester Guardian*), to show that the acquisition of this valuable collection is indeed a piece of singular good fortune for the Manchester Museum, and therefore for all students of ornithology in the neighbourhood, and to call forth expressions of gratitude towards the generous benefactor who has rendered it possible for the museum to possess itself of such treasures.

Considerable changes have recently been made in the arrangement of the zoological collections at the Science and Art Museum, Dublin. These are in two rooms, the upper having a gallery round it. The upper room contains the general zoological collection, systematically disposed. The visitor is supposed to ascend to the gallery by a staircase marked No. 1; this lands him opposite the Protozoa. Thence he follows the gallery round from left to right, viewing on his way the various phyla of Invertebrata in ascending order.

Descending by another staircase, he finds himself close to the Tunicata, and so passes down the room between members of the whole Chordate series up to man. A noticeable feature of the arrangement is the position of the Echinoderma at the head of the Invertebrate series—that is to say, next to the lowest Chordata, with which they are supposed to be in a measure connected, owing to resemblances in the larval forms. The lower room is divided into three sections by large cases placed back to back. Section A contains collections illustrating the facts of geographical distribution; Section B contains the Invertebrata, and C the Vertebrata, of Ireland, and in this series an attempt is made to display every species of the Irish fauna. Exigencies of the museum building have rendered it necessary to maintain the fossils as a separate collection; this also is arranged systematically, on a similar plan. A guide, sold for ½d., instructs the casual visitor as to the route he should follow in order to obtain some idea of the classification of the animal kingdom.

The meeting of the Museums Association held at Brighton from the 3rd to the 6th of July, though not largely attended by either members from a distance or local well-wishers, was distinguished by the amount of serious work and discussion that was got through, and the absence of purely gaseous matter. The Mayor of Brighton made an excellent honorary president, and delegated the task of delivering an opening address to Mr. Henry Willett, who scattered over a wide field his suggestive and humorous remarks. Mr. G. H. Carpenter described the re-arrangement of the natural history collections in the Science and Art Museum, Dublin, and we give the gist of his paper in the above paragraph. Mr. H. Coats sent a note on a children's prize essay competition in the Perth Museum; he seems to have met with success, but the idea of inciting children to this study by means of rewards, was opposed by some curators experienced in this matter. Mr. A. M. Rodger of Perth showed an insect box adapted for exhibition or for stowing away as a drawer. Mr. B. Lomax gave an interesting account of the perpetual exhibition of living plants in the Brighton Museum. Mr. J. V. Hodgson described the preparations for the new museum at Plymouth, and was asked by many of his fellow-curators whether nothing could be done to render the valuable Cottonian collection of art objects more accessible to students and to the public. Mr. B. H. Mullen again brought up the subject of a directory to the Museums of the United Kingdom, a work that would be of use to many besides the curators themselves. Mr. Harlan J. Smith sent some valuable suggestions as to the preservation of local archaeological evidences, as well as a description of the Museums of British Columbia, previously published in the *American Naturalist*. Another previously published paper was that on ink and paper for museum labels, by Dr. R. T. Jackson, which appeared in the *Proceedings* of the American Association for the Advancement of Science, and was now communicated by Mr. F. A. Bather, with the result of initiating a long discussion. A paper by Mr. Stewart Culin of Pennsylvania University gave a laudatory description of some museums in Dresden and Berlin. Museum preparations of marine animals by Dr. H. C. Sorby, ethnological photographs by Dr. H. O. Forbes, paper-covered tablets from the Horniman Museum, and a gorilla mounted by Brazenor Brothers for the Bristol Museum, were among the objects on view. During the week members visited the Brighton Museum under the guidance of Mr. Lomax, Mr. E. Crane, Mr. Thomas, and Prof. Boyd Dawkins; and the Booth Bird Museum under the lead of Mr. A. F. Griffith; the Aquarium, the apartments of the Pavilion, in which building the business and convivial meetings were held; and finally, in charge of Mr. E. A. Pankhurst, they went as guests of the local committee to Lewes, where papers were read by Messrs. C. Dawson, J. Lewis, and G. de Paris.

We have received a prospectus of the exhibition of horticultural photographs which will be arranged in connection with the fourteenth "One and All" Flower Show at the Crystal Palace on the 14th and 19th August. In one class the

judges will for educational reasons depart from their custom and state the grounds on which the judgments are based. A statement of these will be affixed to the exhibits. The honorary secretary is Mr. Edward Owen Greening, 3 Agar Street, Strand.

We learn from the *Daily Chronicle* that when the coal boring was put down at Dover about six or eight years ago by Mr. F. Brady on the site of the old Channel Tunnel works, there were indications in the cores of the presence of iron ore in the strata between 500 and 600 feet from the surface. The indications have now proved correct.

In the course of sinking the No. 2 shaft, a bed of valuable oolitic iron ore has just been struck, at a depth of rather less than 600 feet. The seam proves to be no less than 12 feet thick, and probably extends over a very great area, the quantity being practically unlimited. The diameter of the shaft is 20 feet, and the quantity brought to the surface in passing through the 12 feet amounted to about 350 tons. Samples of the ore have been submitted to analysis, with highly satisfactory results, a washed sample of the ore yielding 45·8 per cent of iron. The analysis shows that the ore is free from sulphur and phosphorus, and it is stated to be of much richer quality than the Wealden ironstone worked in Kent and Sussex a century ago. Prof. Boyd Dawkins, in a paper read before the British Association in 1894, described a sample obtained from the original boring. From this it appears that this bed of iron ore is identical with that described by Blake and Hudleston at Abbotsbury in Dorset, where it occurs between the Kimmeridge clay above and the Coralline rocks below. It is also physically identical with the valuable iron ore worked for many years in Westbury, Wiltshire. The ironstone presents very singular physical characteristics. It is composed of dark brown, shining grains of hydrated oxide of iron, like millet seed, embedded in a crystalline base partly of calcium carbonate and partly of iron carbonate.

The last year has been, we learn from the *Scientific American*, the most successful in the history of the U.S. Fish Commission. Millions of shad, trout, cod, and other fry have been distributed. It is said that the cost of shad has been decreased to the consumer by more than 30 per cent.

The *British Medical Journal* publishes an inaugural lecture, delivered by Major Ronald Ross at the Liverpool School of Tropical Medicine, on the possibility of eradicating malaria from certain localities by killing off the mosquitoes (*Anopheles*) from the puddles.

We learn from *Nature* that the *Academy* invited its readers to compose an inscription of not more than forty words, suitable to be engraved upon the statue of Charles Darwin, recently unveiled at Oxford. The following, by Mr. Edwin Cardross, was considered best:—"Charles Darwin, the great naturalist, memorable for his demonstration of the law of evolution in organic life, achieved by scientific imagination, untiring observation, comparison, and research; also for a blameless life, characterised by the modesty, 'the angelic patience, of genius.'"

The *Scientific American* reports that the North Dakota Senate has passed a bill requiring all applicants for marriage licences to be previously examined by a board of physicians as to their mental and physical fitness. The certificates must show that they are free from hereditary diseases, with special reference to insanity and tuberculosis. "Legislation of this kind is interesting, but that is about all that can be said for it, for there is nothing to hinder the contracting parties from going over the border into adjoining States to have the ceremony performed."

Dr. Otto Thilo, Riga, Russia, makes an appeal for information regarding the fish *Thalassophryne*, which he wishes to investigate in connection with his work on poisonous organs.